IN THE HON'BLE HIGH COURT OF JUDICATURE OF BOMBAY AT PORVORIM, GOA

PIL WRIT PETITION NO. 6/2024

THE MULAKH KHAZAN FARMERS ASSOCIATION AND ANR. ...**Petitioners**

vs.

THE DIRECTORATE OF MINES AND GEOLOGY & ORS. ...**Respondents**

WRITTEN SUBMISSIONS/NOTE BY THE PETITIONERS

1. The problems caused by the bulk transport of minerals (iron ore) through mining villages in the mining zone of Goa have plagued village communities in the past and will continue to affect them in the future, unless the government accepts that the rights of the villagers to a clean, healthy and pollution-free environment is the primary consideration that should guide the authorities when granting transport permissions to the mining companies / transporters of the minerals, rather than the commercial interests of the latter. Some regulations had been made by the Goa Government from time to time, but they were grossly inadequate, and worse still, poorly implemented. The Supreme Court in its judgment in 2018 in GF-II described the *mining activities in Goa as "rapacious mining"*.

2. The poor implementation of norms led to road deaths, insufferable dust pollution; destruction of roads and water delivery infrastructure; occupation of the road by heavy vehicles from dawn to dusk; and the degeneration of peace and quiet and quality of life in the villages. The villagers often protested vociferously and were thrown into jail as a consequence.

3. With a fresh regime of mining now commencing, it was necessary that the transportation Rules ought to have been comprehensively re-examined, especially in the context of the findings of the 2 year study of environmental impacts of mining done by the Dhanbad Institute of Mines, sponsored by the Ministry of Environment. This was not simply done. Thus, when mining transport resumed in Mayem in 2022-23, the trucks commenced their operations in the wee hours of the morning and plied along the village roads till the late hours of the evening, causing the Mayem villagers to approach this Hon'ble Court in a P.I.L. to stop the transportation through their village. The petitioners relied on an Office Memorandum issued by the Ministry of Environment dt. 29.10.2014, which states that it is based on the recommendations of experts and the objective specifically to alleviate the adverse effects of mining on people and their environment.

4. Recognizing that this problem would continue since e-auctioned ore, dump mining activity and fresh mining extraction will continue, not just in Mayem but elsewhere too, and further, that the response of the authorities to the PIL

indicated that there was no coordination between the Directorate of Mines and Geology and the Goa State Pollution Control Board - with each passing the buck to the other - the Court decided to expand the scope of the PIL in order to provide relief to all villages affected by mining activities.

5. As a result of this Court's intervention, an S.O.P. was evolved jointly by the D.M.G. and the Goa S.P.C.B., which now, in the humble submission of the petitioners, imbibes the spirit of the Office Memorandum dt. 29.10.2014. The SOP is not challenged by the petitioners, who are largely satisfied by its provisions, with the exception of three issues:

    i. Timings for transportation of minerals through the villages;
    ii. The number of trucks permitted to transport ore per hour during the allocated period;
    iii. The monitoring of the pollution generated from the transport.

6. In this context, the petitioners are asking this Hon'ble Court to consider certain changes to the S.O.P. framed by the Directorate of Mines and Geology [SOP is at *pg. 114 of the paperbook*] and the monitoring carried out by the Goa State Pollution Control Board *[Recommendation of the GSPCB is at pg. 260]*. Petitioners' suggestions are with reference to any ore that is transported through the village roads / public roads.

I. - ***Re. timings for transportation of minerals through the villages***

SOP Condition No. 7: "The timing of the Ore Transportation along the designated route should be from 8.00 am to 1.00 pm with a break from 1.00 pm to 2.00 pm and then transportation can continue from 2.00 pm to 5.45 pm from the source location."

Suggested change – The timing for commencement of ore transportation in the morning ought to be 9 A.M., and not 8 A.M.

Reasoning – The time period of 8 A.M. to 9 A.M. is the peak time for people travelling – in terms of large numbers of children going to school - walking or taken by two wheelers - youth going to college and training centres, mostly on two wheelers and driving with the exuberance of youth, and adults going to work by bus, two / four wheelers, anxious to reach on time to the office. Heavy truck movement in this time period is dangerous for human safety, for it would seriously impede and inconvenience the day to day travel of a large number of people during this period from 8 A.M. to 9 A.M.

II. ***Re. the number of trucks permitted to transport ore per hour during the allocated period***

SOP Condition No. 4 – "On the Bhumija Portal GEL through VTS System shall ensure that the total number of trips shall be restricted per Operator on the route to min. 20 and maximum 40 per hour."

Suggested change – Total number of trips ought to be restricted to the minimum or less than 20 trucks per hour, and not the upper cap of 40 trucks per hour.

Reasoning – The number of trips per hour indicated in the S.O.P. is the one-way movement of mineral laden trucks along a given route. When one takes into account the fact that the trucks return along the same route to go back to the source point to load more ore, the actual number of trips per hour is effectively doubled – i.e., it would amount to 40 – 80 trips per hour.

The frequency of trucks passing by would thus be as follows:

- 40 trips per hour = 1 truck passing by every 1 ½ minute
- 80 trips per hour = 1 truck passing by every 45-50 seconds.

No technical study has been done of the actual carrying capacity of village roads. The present figure proposed in the S.O.P. is an ad-hoc figure, not backed by data. Constant movement of the trucks along the narrow village roads

(generally around 4-5 metres wide and with no pavements) would be hazardous for the locals. Hence, petitioners request this Hon'ble Court to direct that the total number of trips ought not to be higher than 20 (load) trips per hour [*which works out to 40 trips both ways, per hour*].

III. ***Re. the monitoring of the dust pollution by the GSPCB***

The monitoring of ore transportation proposed to be done under the new regime is the same as carried out previously, i.e with the installation of monitoring stations at some places along the ore transportation route, readings of air quality taken twice a week and averaged out for 24 hours and results obtained after 6 days! The use of 24-hour ambient air quality monitoring data for truck transport of ore is wholly inappropriate, since the truck transport does not happen over a 24-hour period, as is the case with an industrial unit working 3 shifts. Thus, while the actual transportation period in which air pollution levels are higher is approximately 8 hours only, these air pollution readings are merged into the readings captured over the period of 24 hours, which results in the air pollution levels being averaged out and almost always being with permissible limits, on account of no major activity taking place in the balance 16 hours [*i.e. of non transportation*]. The averaged pollution level readings are thus deemed to be within the norms (Ambient Air Quality for Residential Areas)

Suggested change –

Petitioners make two suggestions:

a. The monitoring of air pollution by the P.C.B. needs to be done daily and exclusively within the ore transportation timings [8/9 A.M. to 5:45 P.M.];

b. Monitoring should be in the nature of real time, on line monitoring, with the equipment linked with the PCB servers and Panchayat.

Reasoning –

As the present monitoring system neither indicates a true picture of dust pollution levels during ore transportation nor does it enable the Board to respond quickly by reducing the transport or shutting it down temporarily, a more focused method is required to achieve proof of air pollution and most importantly, enable the Board to conduct what is actually "point source" monitoring.

Secondly, while the movement and timing of trucks is already subject to real time monitoring on-line by the DMG, the measurement of pollution levels (*in terms of PM10 and PM2.5*) is available only 6 days after the actual events, due to outdated technology. With this outdated system, the chance of policy intervention and quick action being taken against excessive pollution is ruled out.

The need of the hour is to ensure the updation of pollution monitoring technology to keep up with scientific advancements. Real time monitoring of air pollution levels will enable the Pollution Control Board to swiftly take action in the event air pollution levels are breached on a particular day.

The petitioners plead that this Hon'ble Court recommend to the Board to invest in and use low-cost air quality monitoring for dust pollution in village settlements and crowded roads (used by trucks) in the forthcoming season itself, commencing September 2024. Costs may be recovered from the transporter. Such a system can even be rented for the purpose of transportation of e-auctioned ore, which is actually never ending: at present there is an application for permission to e-auction another 2 million tonnes of ore recently filed by the Goa Government in the Hon'ble Apex Court.

The Board must take a pro-active approach since we are entering a new phase of mining. Trials of the new, low-cost electronic sensor-based air quality technologies (also used by *Govt. Pollution Control Boards in Rajasthan, Maharashtra and* Karnataka - *See Exhibit A-1 and A-2 enclosed hereto*) should be started during the monsoon itself, so that the difference between pure air and polluted air will be obvious, if pollution is generated by this activity, as has been our experience in the past.

The low-cost systems suggested (or any other sensible equivalent) would enable the person at the monitoring station / P.C.B. officer to immediately shut down the activity or warn the transporter (and connected leaseholder), if the PM standards (100 for PM10 and 60 for PM 2.5) are breached. This would be similar to the real time action that the D.M.G. states it will take if the number of trucks deployed is in violation of the number permitted, or if stipulated speed levels are exceeded.

A leading and widely used low cost air quality monitoring device which has been deployed in 20 cities across India including New Delhi, Ahmedabad, Haryana, Rajasthan and Meghalaya is the 'ATMOS' real time Air Quality Monitoring Device, developed by the research team at IIT Kanpur. The features of this device are:

- It enables real time monitoring of PM 1, PM 2.5 and PM 10 levels.
- The average cost per unit is Rs 30,000/-.
- It has an inbuilt GPRS module and does not require additional WIFI /network setups.
- Monitoring data is transmitted real time and is accessible on an online dashboard.
- On a full charge, the device can monitor air levels for a period of 8 hours.

Details about this ATMOS Device as well as a 2019 Research publication focusing on the deployment of this device in Delhi are enclosed at **Annexure A-3 Colly.**

The petitioners plead that this Hon'ble Court suggest to the Goa State Pollution Control Board to look into and favourably consider the use of such low-cost air quality monitoring devices for the real time monitoring of air pollution levels in Goa in the forthcoming season itself which starts in September. If the petitioners could come up with information in 24 hours by browsing the internet, surely the Board can do much better.

27.06.2024
Adv. Norma Alvares,
[for the Petitioners]

Enclosed documents:

1. ***EXH. A-1*** - Article published in the 'Indian Express' newspaper, titled 'Low cost, sensor-based monitors effective in tracking air quality: Study', dt. 19th June 2021.

2. ***EXH. A-2*** - Article titled 'Ericsson, IIT Kanpur & Airtel collaborate with Rajasthan Pollution Control Board to monitor air quality in Jaipur', dt. 14th March 2022.

3. ***EXH. A-3 Colly:*** Details of the 'ATMOS' real time air quality monitoring device, including technical specifications and price; as well as a 2020 Research paper published in 'Sensors' [an international peer reviewed technology journal], titled 'Validation of Low-Cost Sensors in Measuring Real-Time PM10 Concentrations at Two Sites in Delhi National Capital Region'].

EDITION INDIA

Wednesday, Jun 26, 2024
EPAPER TODAY'S PAPER

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NewsIndiaLow cost, sensor-based monitors effective in tracking air quality Study

Low cost, sensor-based monitors e tracking air quality: Study

The sensors, which measure ambient air quality, feature real-time communication f

By: Express News Service
Mumbai | June 19, 2021 01:32 IST

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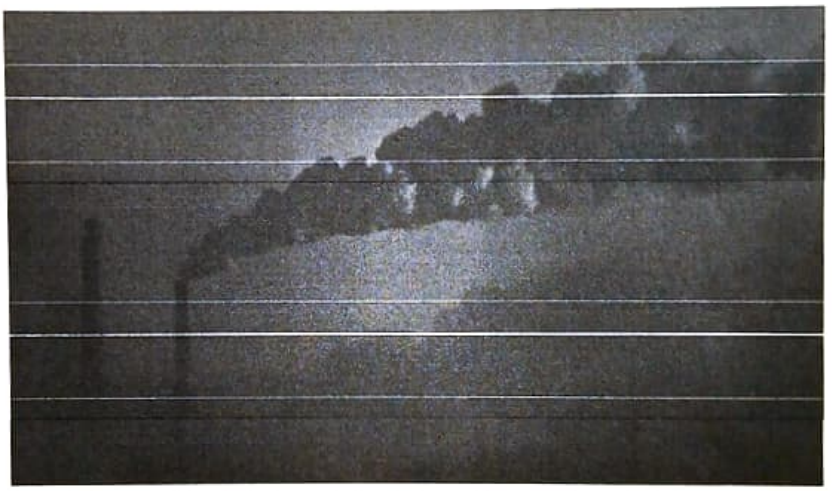

While regulatory grade monitors that are currently in use could cost upward of Rs 20 lakh, these small sensors cost around Rs 60,000. (Unsplash/ Representational)

The 20 low-cost sensor-based air quality monitoring equipment developed by indigenous start-ups have shown an accuracy of nearly 85-90% compared to currently in use regulatory grade monitors, a seven-month pilot project conducted by the Maharashtra Pollution Control Board (MPCB) in partnership with the Indian Institute of Technology, Kanpur (IIT-K) and Bloomberg Philanthropies has found.

The sensors, which measure ambient air quality, feature real-time communication for data transmission of the air quality.

These 20 sensors were among 40 low-cost sensors developed by four different start-ups and were deployed for the study between November 2020 and May 2021 in the Mumbai Metropolitan Region (MMR) alongside MPCB's 15 existing continuous (real-time) ambient air quality monitoring stations.

While regulatory grade monitors that are currently in use could cost upward of Rs 20 lakh, these small sensors cost around Rs 60,000.

The findings of the study were presented at a webinar on Friday with participants from the Ministry of Environment and Forests (MoEF), Forest and Climate Change, the Ministry of Housing and Urban Affairs, Central and State Pollution Control Boards, technical experts, and civil society to discuss the way forward under the NCAP, which plans to expand the air quality monitoring network in the country.

Prof S N Tripathi, Head of Department of Civil Engineering, IIT Kanpur and National Coordinator, National Knowledge Network, NCAP said, "The future of air quality monitoring lies in a hybrid approach .."

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Sudhir Srivastava, Chairperson of MPCB, said, "We have about 100 monitors for the state's large area and this is a patchy network … but we realise that the cost of regulatory grade sensors is a prohibiting factor. Through the study, we now have a lot of data and it enables us to compare it (data from low-cost sensors) with regulatory grade monitors."

Ericsson, IIT Kanpur & Airtel collaborate with Rajasthan Pollution Control Board to monitor air quality in Jaipur

Ericsson (NASDAQ : ERIC) , Indian Institute of Technology Kanpur (IIT Kanpur) and Bharti Airtel ("Airtel"), India's premier communications solutions provider, have collaborated with the Rajasthan Pollution Control Board (RSPCB) to deploy Narrow Band - IoT sensors in Jaipur city to monitor air pollution in real time and raise public awareness.

PRESS RELEASE | MAR 14, 2022

The low-cost Narrow Band-IoT based air quality sensors have been installed at 40 key locations in Jaipur. These sensors are compact, simple to install, and require minimal maintenance. The real-time data collected by the sensors is analyzed by RSPCB and displayed to the public at five identified locations in the city - Yadgar Jaipur; Near VKIA Police Station Jaipur; Govt. Secretariate Jaipur; Airport Sanganer Jaipur; and RSPCB Head Office Jhalana-Dungri Jaipur. These displayed data will include PM2.5, PM10, and air quality index (AQI) concentrations.

In addition to increased public awareness, this will support policy intervention, and enable corrective actions to be taken to reduce air pollution.

As part of the collaboration, IIT Kanpur is also launching a mobile app for easy access to the air quality data. This will not only help in understanding the generated data on PM and AQI in a more meaningful way but also aid in raising public awareness about air pollution levels among Jaipur residents.

Ms Veenu Gupta, Chairperson, Rajasthan State Pollution Control Board states, "I am very happy to launch this project and appreciate the efforts made by IIT Kanpur, Ericsson and Airtel in developing and supporting this low cost sensor network project in Jaipur. It will help in

better understanding of the air quality of Jaipur and formulating a scientific action plan for control of air pollution in city".

Prof. Sachchida Nand Tripathi, Department of Civil Engineering, IIT Kanpur said "The collaboration with Ericsson mainly by implementing NB IoT has helped sensors data transmissibility, reduced power consumption and increased battery life. This has resulted in more autonomous sensor network."

Sonia Aplin, Head of Marketing & Communications, SCR and GIR, Ericsson South east Asia , Oceania and India states, "Having successfully deployed our NB-IoT sensor based solution for measuring air quality in Delhi, we are happy to scale and deploy this solution in Jaipur city. This project will enable Jaipur city to better manage the pollution levels by creating awareness amongst residents and authorities, leading to better air pollution management. At Ericsson, we are committed to working with partners across and beyond the ICT ecosystem to improve lives and build a sustainable future."

Mr. Sundereshwaran Raman, Head of Digital Products, Airtel Business shared "Our mission is to leverage Airtel's IoT capabilities for serving our customers and also for the larger good of the society. Pollution and climate change are critical agendas for all of us and we, at Airtel, are delighted to join forces with Ericsson, IIT-Kanpur and RSPCB to help improve air quality in the city."

The partnership will also include working with community-based organizations to raise awareness regarding air pollution and steps that can be taken to reduce it. To date, 10 institutions, schools, and community groups have been paired with the initiative and 85 students have been trained as air quality champions to participate in monitoring and developing actions to reduce air pollution.

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atmos-MOBI

An affordable, portable, ambient air quality monitor for mobile monitoring of particulate matter, temperature and relative humidity

FEATURES

- IoT technology
- Real-time air quality data transmission
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- WiFi | GPS | 4G*
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- Battery backup (6-7 hours, 12-14 hours*)
- Solar compatible device*
- Data frequency of 1 minute (default)
- Vehicle mountable device

Optional features to meet your air quality monitoring needs

BENEFITS

ACCURACY: atmos is scientifically validated by leading global scientific agencies to deliver high-precision measurement results for small to large-scale industrial, scientific or academic applications

INSTALLATION: Is easy and last mile deployments can be made available on request

MAINTAINANCE: Sensors require minimal maintenance as they are pre-calibrated in factories. Replacement of sensors is easy and as per requirements

DATA ACCESS: Data can be accessed through

1. SD card (manually or wirelessly)
2. API links
3. Cloud-based analytics dashboard (cluster map visualisations, averaging feature & statistical analysis)

WARRANTY: The sensors are covered for up to one year against manufacturing defects

WEATHERPROOF: The devices use an IP65 enclosure but to provide additional protection to airvents a weatherproof case* can be provided

CUSTOMISED: You can choose from a range of customisations to suit your air quality monitoring requirements

Scan code to view our complete range of air quality monitoring solutions

SPECIFICATIONS

PRODUCT SPECIFICATIONS

Dimensions: 170x125x67 mm
Weight: 400 gms
Accessories: Adaptor(5v,2A) x 1
Charging Cable (106 cm) x 1
Vehicle mount x 1
Power rating: 5V, 2A (max.)

SENSOR SPECIFICATIONS

Particulate matter (PM1, PM2.5 & PM10)

- Detection method: Laser scattering
- Detection threshold: 0 to 1,000 µg/m3
- Resolution: 1 µg/m3
- Accuracy: ~0.8R2, ~MAPE 15%

Ambient Temperature

- Detection threshold: -10 to 45 deg C
- Resolution: 0.5 deg C
- Accuracy - ± 0.5 deg C

Ambient Relative humidity

- Detection threshold: 0 to 100%
- Resolution: 1%
- Accuracy - ± 1%

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Our monitors are scientifically validated to help families, air quality professionals, institutions and government make better air quality decisions.

Affordable

Our devices precise enough for academic or scientific purposes, whilst the cost ensures that it can be used by households and enthusiasts too.

Real-time Data

The data from the devices is transmitted every minute, and is available on our map-based dashboard.

Mobile Connectivity

Atmos is one of the few devices in the country that require no wifi network. It comes with an in-built GPRS/GSM module, that requires no setup whatsoever.

Measure what Matters

Particulate matter (PM) of different sizes affects our airways and lungs in different ways. Our monitor measure PM1, PM2.5 and PM10, in addition to temperature and humidity in the air around you.

Precise Calibration

Atmos devices have been scientifically validated against Federal Equivalent Method (FEM) grade equipment.

Easy to Install

When you buy an Atmos device, all you need to do is find a sheltered outdoor space to place it and a power outlet to plug it into. Without power the device's battery can last upto 8 hours.

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Atmos Partners

Mentions

Tech Specs

1. Measure Real-time Ambient Particulate Matter PM_1, $PM_{2.5}$ & PM_{10} $\mu g/m^3$.
2. Measure Temperature (T) & Relative Humidity (RH).
3. Transmit this data in Real-time using an in-built GPRS/GSM module. Data is transmitted to a cloudserver using HTTP protocol.
4. Device has an in-built battery which can keep the monitoring device running for up to 8 hours.
5. Data will be available to be viewed on a map based dashboard.
6. Real-time Air Quality data will also be available to download in a CSV file as well as available for integration in a mobile App or Website using APIs that we will provide.
7. Data is also stored internally on a MicroSD card. Users can download data locally from the SD card too.
8. The linear regression between the Atmos devices and the FEM equipment under different conditions has varied from 0.7 to 0.9.

To buy an Atmos device, contact us at [illegible]

Publications

Sahu, Ravi, Ronak Sutaria, Sachchida Nand Tripathi, et al. (2020). **"Validation of Low-Cost Sensors in Measuring Real-Time PM10 Concentrations at Two Sites in Delhi National Capital Region."** Sensors 20, no. 5 (2020): 1347.

Zheng, T., Bergin, M. H., Sutaria, R., Tripathi, S. N., et al. (2019). **Gaussian process regression model for dynamically calibrating and surveilling a wireless low-cost particulate matter sensor network in Delhi.** Atmospheric Measurement Techniques, 12(9), 5161-5181.

Zheng, T., Bergin, M.H., Tripathi, S.N., Sutaria, R., et al. 2018. **Field evaluation of low-cost particulate ensors in high-and low-concentration environments.** Atmospheric Measurement Techniques

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Article

Validation of Low-Cost Sensors in Measuring Real-Time PM_{10} Concentrations at Two Sites in Delhi National Capital Region

Ravi Sahu [1], Kuldeep Kumar Dixit [1], Suneeti Mishra [1], Purushottam Kumar [1], Ashutosh Kumar Shukla [1], Ronak Sutaria [2], Shashi Tiwari [3] and Sachchida Nand Tripathi [1,*]

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Received: 16 December 2019; Accepted: 19 February 2020; Published: 29 February 2020

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Abstract: In the present study, we assessed for the first time the performance of our custom-designed low-cost Particulate Matter (PM) monitoring devices (Atmos) in measuring PM_{10} concentrations. We examined the ambient PM_{10} levels during an intense measurement campaign at two sites in the Delhi National Capital Region (NCR), India. In this study, we validated the un-calibrated Atmos for measuring ambient PM_{10} concentrations at highly polluted monitoring sites. PM_{10} concentration from Atmos, containing laser scattering-based Plantower PM sensor, was comparable with that measured from research-grade scanning mobility particle sizers (SMPS) in combination with optical particle sizers (OPS) and aerodynamic particle sizers (APS). The un-calibrated sensors often provided accurate PM_{10} measurements, particularly in capturing real-time hourly concentrations variations. Quantile–Quantile plots (QQ-plots) for data collected during the selected deployment period showed positively skewed PM_{10} datasets. Strong Spearman's rank-order correlations (r_s = 0.64–0.83) between the studied instruments indicated the utility of low-cost Plantower PM sensors in measuring PM_{10} in the real-world context. Additionally, the heat map for weekly datasets demonstrated high R^2 values, establishing the efficacy of PM sensor in PM_{10} measurement in highly polluted environmental conditions.

Keywords: urban air pollution; PM_{10}; real-time monitoring; low-cost sensors; data merging tool; data validation

1. Introduction

One in eight deaths in India is said to be caused by air pollution, according to a report co-authored by the Indian Council of Medical Research [1]. Particulate matter (PM) includes inhalable PM (PM_{10}, aerodynamic diameter ≤ 10 μm) and finer PM ($PM_{2.5}$, aerodynamic diameter ≤ 2.5 μm), and PM-based air pollution is said to be the leading cause of deaths from ambient air pollution [2–4]. The annual average PM_{10} and $PM_{2.5}$ concentrations in Indian cities were found to be 106.4 and 58.6 $\mu g \cdot m^{-3}$, respectively, with every 10 $\mu g \cdot m^{-3}$ increase in $PM_{2.5}$ increasing all-cause mortality by between 3% and 26%, chances of childhood asthma by 16%, chances of lung cancer by 36%, and heart attacks by 44%. India, as of January 2020, has around 200 citizen-facing Continuous Ambient Air Quality Monitoring Stations (CAAQMS), which provide real-time $PM_{2.5}$ or PM_{10} information to people. The country has

over 4000 cities and towns where real-time air quality monitoring stations are required to be installed. The "affordable" or "low-cost" sensor devices to measure these PMs is a promising technology for increasing the density of the sparse urban PM pollution monitoring network [5–8]. In developing countries like India, the implementation of such technology becomes a very relevant solution for large-scale deployment of a nationwide air quality monitoring network [9–11]. Measurements of air pollution underpin a wide range of applications that extend from academic investigation to regulatory functions and services for the general public, governments, and businesses [12]. A nationwide dataset on air pollution is required to raise awareness of pollution and for advancing research in associated fields. Public and media attention is increasingly conscious of the health and economic expenses of high outdoor PM pollution.

Consequently, start-up companies are stepping up to produce affordable, user-friendly, and very compact wireless PM sensors to monitor air pollution [9,13–16]. These devices have the potential to bridge gaps between sparse government measurements and research groups to assess their exposure [17,18]. This wide-ranging use of this technology presumes that these portable, low-cost air pollution sensors are fit for PM measurements, although the analysis of the data quality is a subject of lively debate [19,20]. Lewis and Edwards [20] commented that the penetration of these devices into the public domain, generating a large amount of unproven data, is inevitable. Since low-cost PM sensors have not been scientifically evaluated and certified by regulatory agencies as yet, there is a significant need for benchmarking them against accurate monitors before deploying into the field conditions. Efforts from environmental technologists are of utmost importance so that these emerging technologies can realize their true potential [10,21]. The United States Environmental Protection Agency (US EPA). approved instruments for measuring PM concentrations include impactors, cyclones, Tapered Element Oscillating Microbalances (TEOM), and Beta Attenuation Monitors (BAM) [22]. These techniques are the US EPA-approved Federal Reference Methods (FRMs) of measuring PM for aerodynamic size less than 2.5 μm ($PM_{2.5}$) and size less than 10 μm (PM_{10}) from the ambient. These techniques, however, are reported to neglect the prospect of being able to correlate the variations in short-term intra-day atmospheric parameters [23,24].

Consequently, these non-continuous techniques can affect ambient particle concentration [24]. On the other hand, a continuous method could obtain PM_{10} levels through measurements by a combined system comprising of certified instruments, i.e., scanning mobility particle sizer (SMPS) and optical particle sizer (OPS) or aerodynamic particle sizer (APS). These derive particle mass concentrations from measured particle size distributions [23]. Evaluation of the SMPS–APS system has successfully determined to match well with the reference instrumentations for measuring PM concentrations [24–26]. Moreover, it was demonstrated experimentally that APS and OPS similarly measure PM [27]. Multi Instrument Manager Version 3.0 (MIM™ 3.0), a data merging tool, is useful in providing PM_{10} concentrations from two different research-grade equipment for measuring particulates (in two different ranges) in the absence of a single reference instrument. Notably, in emerging economies around the world, these well-proven techniques would play a vital role in validating $PM_{2.5}$, $PM_{2.5\text{-}10}$ (coarse particles), and PM_{10} sensors.

Continuous PM_{10} measurement instruments, including federal equivalent methods (FEMs) and other standardized research-grade devices, often cost several hundred thousand dollars and, in general, must be run in climate-controlled conditions and with extensive oversight and repairs. These instruments require significant effort to operate continuously for in-depth aerosol-driven deep statistical analysis. It is, therefore, not a cost-effective approach to rely only on these instruments to generate additional insight into pollution behavior across the country [23]. New sensor technologies may address some issues of cost and convenience posed by conventional measurement equipment. On the other hand, sensor-based PM monitors are available in roughly three orders of magnitude lower than standard instruments [10]. The overall budget of execution encompassing all other costs, such as data analytics, sensor replacement timeframe, and sensor calibration, is less well established [23]. The use of affordable miniature sensors is already underway in different applications, such as identifying

hotspots for outdoor pollution, generating additional insight into pollution behavior with higher spatial and temporal resolution, mapping indoor pollution concentrations, accumulating data on personal exposure, and collecting mobile monitoring data [28–30]. Concerns about their precision and performance do remain unanswered [23,30].

In this manuscript, only PM_{10} is compared and not the other important metrics, such as $PM_{2.5}$ or PM_1. Using low-cost sensors, many authors have already well-documented PM_1 and $PM_{2.5}$ across the world. Another work [7] published on the performance evaluation of low-cost PM sensors by some of the authors of our research group evaluated $PM_{2.5}$ using a low-cost PM sensor at IIT Kanpur and Duke University campuses. They validated Plantower PM sensors for $PM_{2.5}$ measurements. They demonstrated field calibration of these PM sensors using Environmental Beta Attenuation Monitor (EBAM) as reference instruments for $PM_{2.5}$ measurements at multiple sites with diverse environments. Mostly, the PM sensors, including the Plantower model PMS7003, are validated for $PM_{2.5}$ measurements. However, to the best of our knowledge, no detailed study in India has been published focusing on the assessment of PM_{10} concentration using low-cost PM sensors in real-world scenarios. We compare our sensors in measuring PM_{10} levels with the co-located SMPS–OPS and SMPS–APS. We collect PM_{10} data during an intense measurement campaign period of seven weeks conducted for pollution monitoring at two selected sites in the Delhi National Capital Region (NCR), India. Merging data obtained from the certified reference instruments result in approximate overall PM mass concentrations. We validate our PM sensors for PM_{10} data with the aid of statistical tools.

2. Materials and Methods

2.1. Study Site

The two selected study sites were Manav Rachna International Institute of Research and Studies (MRIU), Faridabad, (28.45°N, 77.28°E and ~209 m above msl), and Centre for Atmospheric Sciences, Indian Institute of Technology Delhi (IITD), New Delhi, (28.54°N, 77.19°E and ~232 m above msl). These sites are in the Delhi-NCR (which is among the top-ranked polluted megacities in the world) [31]. Both the sites exist in the Indo-Gangetic Plain (IGP), which, due to its geographical components and some specific anthropogenic activities, is considered a hotspot for air pollution [32]. The selected sites suffer from heavy air pollution that masks the whole region, usually during the winter season. The field deployment of $PM_{2.5}$ sensors at similar polluted monitoring sites is reported to perform well [7,33]. We considered only the two polluted locations in the populous Delhi-NCR, India, to cover the higher range of PM_{10} concentration. Our aim was specified to test the low-cost PM sensors in highly polluted cities and find their suitability in PM_{10} measurements.

The PM sensors were mounted on the terrace of the buildings at the respective sites. The research-grade instruments were kept inside the room, while their inlets were connected through tubing for the intake of ambient air from the outside the window. The mounted sensors and reference instruments were deployed such that their sample inlets were very close to each other to provide similar environmental conditions. At first, the two newly developed Atmos devices were installed side by side at the rooftop of Centre for Environmental Science and Engineering, Indian Institute of Technology Kanpur (IITK; 26.52°N, 80.23°E, 142 m msl), India. The ambient environment of Kanpur, India, which also comes in the IGP, is also known for its characteristic high ambient particulate concentrations. Sensors were implemented for two and a half weeks at the IITK site. After attaining sufficient data, these devices were tested for consistency, as described in the methodology section.

2.2. Instrumentation

New Plantower PM Sensor: The new low-cost sensors assessed in this study were Plantower PM sensors (model PMS7003). The Amos device is presented in Figure 1a. These devices are priced at only a fraction of the cost of the reference monitors. The measurement range of the PM sensors used was 0–1000 $\mu g \cdot m^{-3}$, with a resolution of ±1 $\mu g \cdot m^3$ and response time 1–10 s. The dimension

of the miniature PM sensors used was 48 mm × 37 mm × 12 mm, and the temperature and relative humidity ranges were −10 °C to 60 °C and 0% to 99%, respectively. The manufacturer reported that maximum errors were relatively low (±10 $\mu g \cdot m^{-3}$ in < 100 $\mu g \cdot m^{-3}$ concentrations, and ±10% in the 100–500 $\mu g \cdot m^{-3}$ range). The detailed specifications of the PM sensor used in this study are described in Supplementary Table S1. These PM sensors use a laser-scattering technique to measure real-time PM mass concentrations and apportion laser scattering to PM_1, $PM_{2.5}$, and PM_{10}. It is based on a proprietary algorithm that is not fully accessible by others [34]. A detailed description of the working of selected PM sensors is mentioned in a field evaluation study of $PM_{2.5}$ by Zheng et al. [7]. We used the sensor-reported PM_{10} concentration estimates that were un-calibrated. Before field deployment, no attempt was made to calibrate these sensors under laboratory conditions due to a potentially marked discrepancy in particle size, composition, and optical properties of field and laboratory conditions [7].

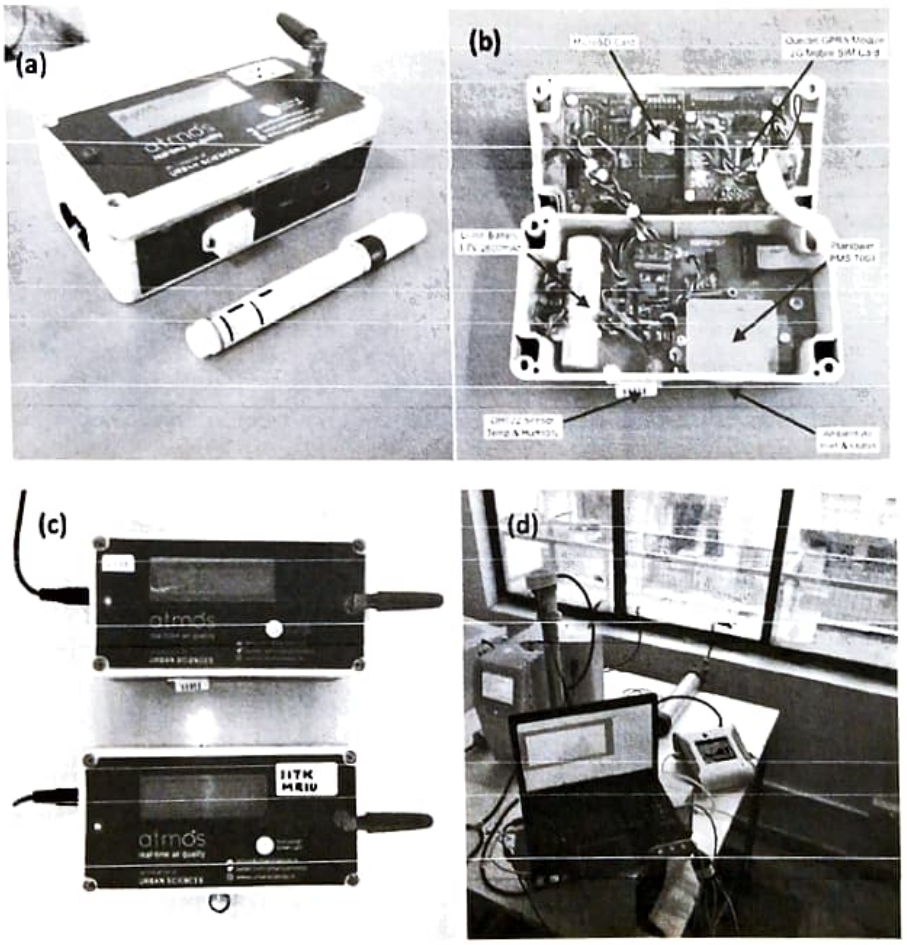

Figure 1. Images from the deployment of low-cost particulate matter (PM) sensors at the study site. (**a**) PM sensor Atmos comparable to the size of a marker pen, (**b**) the PM sensor box housing all components, (**c**) two sensor boxes (used in this study) co-located for consistency test, and (**d**) experimental setup at one of the monitoring sites for ambient air monitoring.

Atmos—Real-Time PM Air Quality Monitors: The newly developed PM sensor Atmos box housing all the components is as shown in Figure 1b. The Atmos device uses the Plantower PMS7003 sensor for measuring PM_1, $PM_{2.5}$, and PM_{10} concentration values. The DHT22 sensor is used for monitoring temperature and relative humidity. The data from both these sensors are transmitted in real-time via a Quectel M66 general packet radio services (GPRS) module using 2G mobile network

connectivity from local mobile service providers. A rechargeable Li-Ion battery provides backup power to the device for 10 hours. In the case of power failure, there is a seamless failover of the power module from the mains power to the backup battery. From our device itself, a local MicroSD card slot allows data to be stored and downloaded. The Atmos unit also has a Liquid Crystal Display (LCD) to view debug messages. The Atmos unit was developed in two models—with an external onboard GPS and without the GPS. The Atmos GPRS model used in this study had dimensions of length 155 mm × width 80 mm × height 60 mm. The Atmos device used the HTTP protocol to send data every 1 minute to the remote Atmos server.

Atmos—Big Data application program interface (API) and Dashboard Access: The Atmos real-time streaming data server was built using open source technologies-Apache Cassandra and *KairosDB*. For fast time-series database access, Apache Tomcat and HTTP server, for custom Java-based API access and HTML5/JavaScript/LeafletJS for interactive Map-based dashboard were used. Data from the Atmos device is received on the server via web services APIs and made available for comma-separated values (CSV) download and programmatic JavaScript Object Notation (JSON) access via custom-built Java APIs. Device nos. 0523 and 1292 were the two Atmos deployed at MRIU and IITD, respectively, after testing their sensitivity at ambient conditions in Kanpur, as shown in Figure 1c.

Reference Sizers: We measured particle concentration in the range of 14 nm–10 μm. We used a combination of an OPS™, Model 3330, TSI Inc., Shoreview, Minnesota, United States of America (USA) (for particles ranging from 0.3 μm to 10 μm), APS™, Model 3321, TSI Inc., USA (for particles ranging from 0.5 μm to 20 μm). The SMPS™, TSI Inc., consisting of an electrostatic classifier, Model 3082, connected to a condensation particle counter (CPC, model 3776, TSI Inc., USA (from 14 nm to 760 nm particles) as shown in Figure 1d. The time resolution for the measurements was 5 min, so that 12 data points of every hour were averaged to get hourly concentrations. The SMPS utilized a differential mobility analyzer (DMA) to classify particles as a function of electrical mobility size. At the same time, with a condensation particle counter (CPC), it determined particle concentrations, giving particle size distributions. Mass concentrations were computed through the integration of the product of the size distribution function and particle mass of every size. We acquired a continuous particle size distribution function through data inversion. It further related particulate concentration to the charging efficacy of the neutralizer, the detection efficiency of the CPC, and the transfer function of the DMA [35]. The merging process was adapted following by the method described by [36], forming the complete size distribution from 14 nm to 10 μm. However, we stated a brief on the merging process in the subsequent sub-section. We applied the necessary corrections in all the reference measuring instruments before merging and during merging, as per the requisite.

Data Merging: We merged the SMPS number distribution data with APS number distribution data using the Data Merger software Module (developed by TSI) to obtain merged mass distribution (dM/dlogDp versus Dp). During the monitoring period, we averaged the samples recorded every hour at the time of data merging. We then summed the hourly mass distributions using the trapezoidal rule to acquire hourly PM concentrations.

The SMPS number distribution data were merged with OPS number distribution data using MIM™ 3.0 (developed by TSI) in the mass mode to get PM concentrations for every hour. The MIM software is a MATLAB-based tool that allows reviewing, averaging, merging, and post-processing of data from SMPS and OPS and compiles it into a single, wide-range data set. TSI introduced it after the initial development of dedicated algorithms [37,38]. We averaged samples recorded over one hour during data merging. We then compared the PM_{10} obtained from SMPS and OPS data merging and the PM_{10} derived from the combination of SMPS and APS data. Thus, we tested merging for its suitability in getting SMPS- and OPS-acquired PM mass and also tested for over and under prediction. The merging process eliminated the discontinuity in the number distribution [39]. We took into account the inherent difference between the mobility size measured by the SMPS and aerodynamic diameter measured by the APS. During the merging, the shape factor of 1, as described by Misra et al. [40], and a widely accepted density of bulk atmospheric aerosols equal to 1.2 g.cm^{-3}, was taken in the data

analysis. As described by them, we combined the size distributions from SMPS and APS into a single size distribution (from 14 nm–20 μm) [40]. For this purpose, we used the TSI Aerosol Instrument Manager Program Data merge software module version 3.0.1.0.

2.3. Methodology

The methodology included a consistency check of the Atmos PM sensors used in similar field conditions. It also included correlating site-specific data collected from different combinations of devices and validation of Atmos PM_{10} concentrations using merged data as a reference. The schematic flowchart for this study is shown in Figure 2.

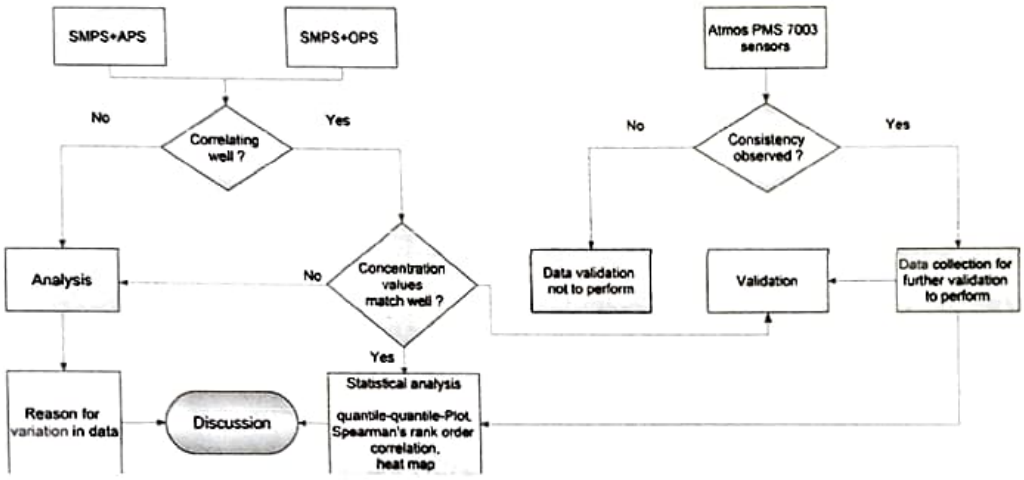

Figure 2. Schematic diagram showing the methodology used in this study.

Although a single manufacturer developed the PM sensors that were used in the studied Atmos boxes, their performance in measuring PM_{10} has not yet been tested in field conditions. First, we checked the sensors for consistency, and then we deployed them in the field next to the inlets of different research-grade PM measuring instruments. We compared sensor data with the merged PM_{10} concentration from the reference instruments. The suitability of using SMPS–OPS merged PM_{10} was evaluated for reference measurements and as an alternative to well-demonstrated SMPS–APS merged PM-products [39]. However, studies have focused on getting number size distribution mostly from the SMPS–APS combination [24,26]. Simultaneously, merged PM_{10} from SMPS–OPS at both the sites (MRIU, Faridabad and IITD, New Delhi) and from SMPS–APS only at one of the monitoring sites (MRIU, Faridabad) was used to validate Atmos PM_{10} measurements.

2.4. Statistical Analysis

The experimental results from the deployment period were statistically analyzed using R packages, namely psych, rcompanion, and ggpubr. This included determining the mean, standard deviation, Quantile–Quantile plot (QQ-plot) formation, Pearson correlation (r), and Spearman's correlation (r_s). We followed a methodology as described in Ann et al. [41], Well and Myers [42], and Cohen [43]. Data were collected and arranged for analysis in a spreadsheet under Microsoft® Excel© 2020. Furthermore, a time series for $PM_{2.5}$, PM_{10}, and coarse particles for the deployment period as well as a heat map were plotted for weekly-basis PM_{10} data during the campaign using Origin pro evaluation, 2018 software. We sought the influence of the sensors' run-time duration on the correlation with the measured PM_{10} concentrations.

3. Results and Discussion

This section discusses various analyses done on the data collected during the considered deployment.

3.1. Consistency Test among the Sensors

Before deployment in Delhi-NCR, we co-located both the selected Atmos devices (device numbers 0523 and 1292, or Sensor 1 and Sensor 2, respectively) for a sufficient duration at IITK, India. A study conducted in Kanpur showed that PM concentration levels are quite high, similar to Delhi-NCR, with a wide-range in PM concentrations [44]. Reported studies have analyzed trends of PM_{10} in Delhi and Kanpur, India, and have found crop residue burning to be a major source. Zheng et al. [7] also selected Kanpur as a site for PM sensor field deployment with characteristic high PM concentrations. Time series and scatter plots observed for the two co-located Atmos devices (sensor one and sensor two) during this period are shown in Figure 3a,b, respectively.

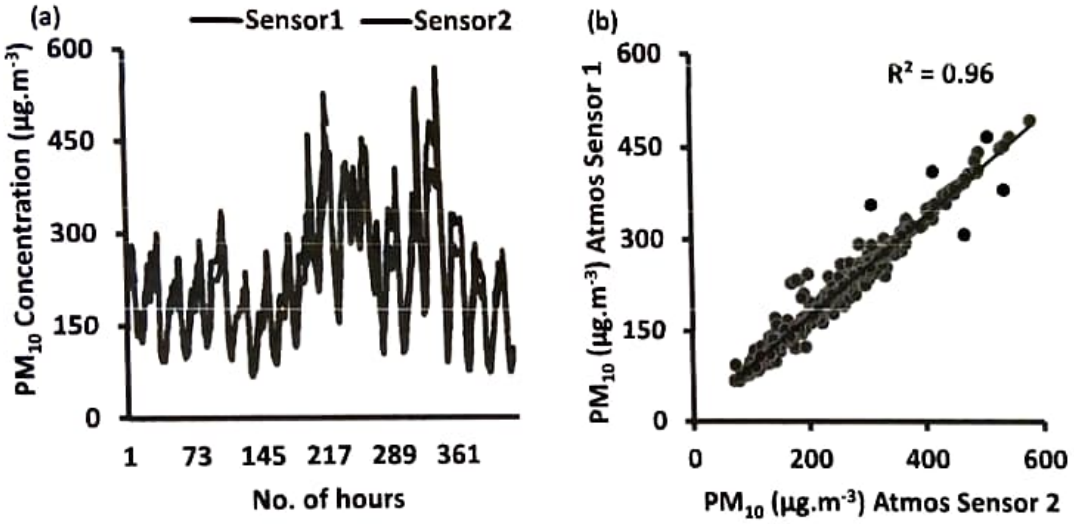

Figure 3. (**a**) Time-series of ambient PM_{10} concentrations ($\mu g \cdot m^{-3}$) from two co-located Atmos PM sensors for consistency test and (**b**) scatterplot for the collected data from two co-located sensors at ambient conditions.

The time series indicated that the ambient PM_{10} concentrations ($\mu g \cdot m^{-3}$) from two co-located Atmos PM sensors (PMS7003) were quite similar for the entire test period of two and a half weeks. We observed that the hourly time series for PM concentrations measured by both the devices matched very well. Consistency was observed between both the devices in measuring the ambient conditions with PM_{10} concentrations <100 $\mu g \cdot m^{-3}$ and ranging up to 579 $\mu g \cdot m^{-3}$. A similar time series or pattern was observed for both the devices without any ambiguities in them. In other words, no significant variation seemed to appear in measured PM concentrations ($p < 0.05$) among the two devices. For the two studied devices, for two and a half weeks, the coefficient of determination (R^2) was found to be 0.97. This indicates a strong correlation between the two sensor boxes. Time series and scatter plots from the two Atmos devices were expected to be highly similar as these were from the same manufacturer, as reported by many authors [7,45]. However, due to limited field evaluation results from the manufacturer, we examined the consistency in the real-world scenario. The cause of slight variations in the ambient PM measurements may consist of instrument contamination, changed fan flow rates, and potentially inadequate cleaning of the sensors [46].

Attempting a consistency test for the PM_{10} measurement of studied Atmos sensors at MRIU and IITD sites provided high confidence in terms of their deployment in the real-world conditions or

fields. Hence, these devices were then co-deployed in the Delhi-NCR next to the research-grade PM measuring instruments.

3.2. Time Series of Measured PM_{10} Concentrations

After collecting sufficient PM_{10} data during the deployment period of 21 January 2018–16 March 2018, time series were plotted for the two study sites, as shown in Figure 4a,b. The PM_{10} time series plots for the two sites consisted of data from SMPS–OPS, SMPS–APS, and Atmos at MRIU and data from SMPS–OPS and Atmos at IITD. Total numbers of hourly averaged data points at MRIU, Faridabad from SMPS–OPS, Atmos PM sensor, and SMPS–APS were 717, 1124, and 766, respectively. The overall mean PM_{10} concentrations measured by SMPS–OPS, Atmos PM sensor, and SMPS–APS were 98.2 ± 65.5 $\mu g \cdot m^{-3}$, 149.2 ± 86.1 $\mu g \cdot m^{-3}$, and 74.4 ± 54.6 $\mu g \cdot m^{-3}$, respectively.

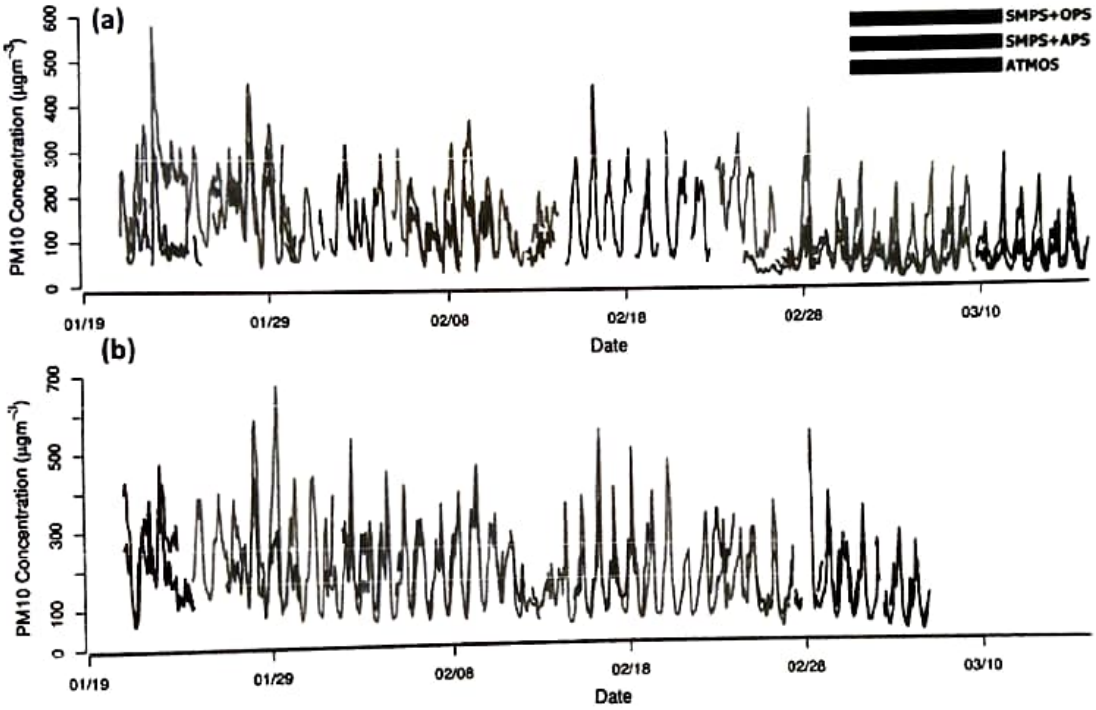

Figure 4. Time series of ambient PM_{10} concentrations ($\mu g \cdot m^{-3}$) data collected from Atmos PMS7003 sensor and reference instruments (merged PM_{10} from SMPS-OPS and SMPS–APS) during the deployment period at (a) Manav Rachna International Institute of Research and Studies, Faridabad (Delhi-NCR) and (b) Indian Institute of Technology Delhi, New Delhi monitoring sites.

The total number of hourly averaged data points at IITD, New Delhi from SMPS–OPS and the Atmos PM sensor was 832 and 1029, respectively. Mean PM_{10} concentrations measured by SMPS–OPS and Atmos were 182.3 ± 84.2 $\mu g \cdot m^{-3}$ and 181.0 ± 111.5 $\mu g \cdot m^{-3}$, respectively. The idea was to look for PM_{10} concentrations patterns of Atmos with SMPS–APS and to evaluate the correlation between SMPS–APS and SMPS–OPS, simultaneously. At both MRIU and IITD sites, trends obtained for measured PM_{10} concentrations by Atmos matched those estimated by the reference instruments. However, Atmos was generally on the higher side among the two tools measuring PM_{10} levels. Similarly, previous studies on low-cost PM sensors have shown that the sensors overestimated ambient $PM_{2.5}$ to that with the reference monitors readings [34,47].

We measured the mean absolute error (MAE) for each of the pairs of datasets. The observed MAE value in measured PM_{10} from Atmos (uncorrected) at the IITD site concerning SMPS–OPS was 68.74 $\mu g \cdot m^{-3}$. On the other hand, observed MAEs in Atmos at MRIU site while comparing with

SMPS–OPS and SMPS–APS were 56.63 μg·m^{-3} and 68.43 μg·m^{-3}, respectively. These uncorrected PM_{10} readings of the sensors have an offset from that of the reference measured concentrations. The potential effect of relative humidity on particle size measurements could be attributed to the offset in measurements of PM sensors [7,17,23,48,49].

The concentration trends of SMPS–OPS were well tracked by Atmos, suggesting SMPS–OPS to be suitable for consideration as a reference for ambient PM_{10} measurements for sites with high PM_{10} concentration environments. This enhances the scope for different research communities to use affordable PM sensors and validate and calibrate PM_{10} datasets using extensive data collection by merging SMPS–OPS data.

As far as the environmental impacts are concerned, the daily PM_{10} concentrations exceeded the Indian Central Pollution Control Board limit (100 μg·m^{-3}) most of the days during the studied deployment period. The PM_{10} mass concentrations at both the sites were quite high during the monitoring period of seven weeks of January-March. The PM_{10} levels are comparable to those estimated by Tiwari et al. [50] measured by the recommended method for multiple sites in Delhi in the same months. In addition to this, the measured PM_{10} mass was highest during the initial monitoring period, which gradually decreased on moving from week 1 to week 7. Nagar et al. [44] also showed that in the winter season, PM_{10} concentrations were higher during the January months in comparison to the next subsequent months. Results from our study are in agreement with the long-term research on seasonal variation and annual pattern in PM_{10} conducted in Ganga Basin [44]. Diurnal variations by both the devices matched quite well. For high PM concentrations, anthropogenic sources like biomass burning products with downwind directions were reported as one of the principal contributors. Crop residue burning is identified and well documented as the primary cause of high PM_{10} concentrations in the studied regions [51–53].

The total number of hourly averaged $PM_{2.5}$ data points at IITD and New Delhi from SMPS–OPS and the Atmos PM sensor, respectively, were the same as those were recorded for PM_{10} (Supplementary Figure S1). Mean $PM_{2.5}$ concentrations measured by SMPS–OPS and Atmos were 117.31 ± 64.7 μg·m^{-3} and 161.70 ± 98.0 μg·m^{-3}, respectively, for the same measurement period. Similarly, at MRIU the mean $PM_{2.5}$ concentrations measured by SMPS–OPS, SMPS–APS, and Atmos were 65.0 ± 51.3 μg·m^{-3}, 72.3 ± 52.2 μg·m^{-3}, and 139.1 ± 74.7 μg·m^{-3}, respectively, for the same measurement period. The $PM_{2.5}$ concentrations from Atmos tracked well the measured concentrations of reference instruments for both the sites. Nevertheless, the values were overestimated as there was a constant offset between the measured concentrations from both.

The idea was to look for PM_{10} concentrations patterns of Atmos with SMPS–APS and to evaluate the correlation between SMPS–APS and SMPS–OPS, simultaneously. At both MRIU and IITD sites, however, Atmos was generally on the higher side among the two devices measuring PM_{10} levels. Similarly, previous studies on low-cost PM sensors have shown that the sensors overestimated ambient $PM_{2.5}$ compared to the reference monitors readings [37,47].

Previous research works have also reported that these sensors determine size fractions differently from exact measurements of PM concentrations [54]. Similarly, the precision levels at various locations may differ depending on the chemical composition and particle size distribution [23]. Again, for the sites with a dominating source like traffic emissions, the changing size distribution on an hourly-averaged basis may also add a distinguishable change in error to the measured PM concentrations [53]. In our case as well, the MRIU site was located in the proximity of a busy cross-town roadway, which was likely to affect the performance of the different PM measuring devices. Moreover, both the locations were urban backgrounds. Hence, the respective environments could be affected by local sources such as campus vehicles, street sweeping, and other local emission sources inside the institutes. Particle measurements, when categorized across various size ranges, could be even more complicated than the analysis of gaseous pollutants. They may be altered by many parameters that vary for different measuring techniques and diverse particle kinds [55].

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3.3. Distribution Pattern and Pairwise Correlation of Measured PM_{10} Data

At first look, the patterns of the PM_{10} concentrations from different instruments appear to track well with each other. Peaks and troughs in the measured PM_{10} levels by Atmos devices for both the sites followed those measured by reference instruments. Therefore, the observed PM_{10} time series indicated to proceed further and look for the correlations among the datasets. To select among available options to find correlation types, we analyzed using QQ-plots for the collected data from each device and from both the sites, as shown in Supplementary Figure S2.

The QQ-plots, as shown in Supplementary Figure S2a–e, demonstrate the normality of data sampled from different instruments used in this deployment. The black line inside the grey area represents the normally distributed theoretical dataset, while the grey shaded area represents the theoretical confidence interval of a normally distributed dataset. The black data points represent the actual sampled data points observed for the studied instruments. If the sampled data falls within the confidence interval, it is generally assumed to be normally distributed. However, from the above figures, it was observed that the sampled data sets were above the confidence interval, which infers that the sampled dataset in our case was positively skewed. This confirms the execution of Spearman's correlation in the collected data set.

As the data collected was positively skewed, we passed both the reference and Atmos data into the ln function, which confirmed that the data was indeed log-normally distributed. The Pearson correlation was estimated for the normally distributed data. This was done after passing the dataset to the log-function. The Pearson correlation for the normally distributed data after moving it into ln-function was 0.67 (slightly better) for SMPS–OPS and Atmos at IITD. The observed correlations between Atmos and merged PM_{10} concentrations for SMPS–APS and SMPS–OPS were 0.93 and 0.84, respectively. Similarly, in the case of $PM_{2.5}$, the Pearson correlation after passing the dataset to the log-normal function was on the higher side. For the IIT Delhi site, it was observed that Pearson correlation = 0.94 between Atmos and SMPS–OPS. While at the MRIU site, Pearson correlation = 0.86, 0.90 between Atmos and SMPS–APS and Atmos and SMPS–OPS, respectively.

The skewed data could be explained by the high seasonal variability of PM concentrations in Delhi—January registers high PM concentrations as compared to that in March [56]. The Spearman method does not assume normality of distribution while calculating the coefficient. It is a non-parametric method of correlation, sometimes also referred to as a distribution-free test, and is often used to calculate the correlation between skewed datasets. Spearman's correlation method has an analogy with Pearson's method [43], which can make it comparable to the Pearson coefficient in an analysis. It was also observed that the spearman correlation method was similar when compared with Pearson's correlation after the dataset was normalized using the ln function. The scatter plots, along with Spearman's correlation for both the sites, are illustrated in Figure 5a–d. Pairwise correlation and data distribution of measured PM_{10} between instruments for MRIU and IITD are presented in Figure 5e,f, respectively.

We observed a p-value < 0.001 for all four cases; this rejects the null hypothesis and suggests that there was a strong dependence between the sampled PM_{10} measurements. The correlation is often defined as simple-specific measure and is also affected by the variability of the sampled data sets [42]. Pairwise correlations illustrated the natural distributions of different data sets collected during the study period. Correlation results revealed that there was a strong linear positive correlation among the sampled datasets. The correlation between merged PM_{10} concentrations for SMPS–APS and SMPS–OPS was found to be 0.92 and was in line with the earlier inferred results. It is hence clear from the r_s values that OPS was able to capture the measurements in variation when compared with APS. Furthermore, data from the SMPS section were common in both the merged PM products. These results support the use of research-grade OPS in combination with SMPS for PM_{10} measurement purposes.

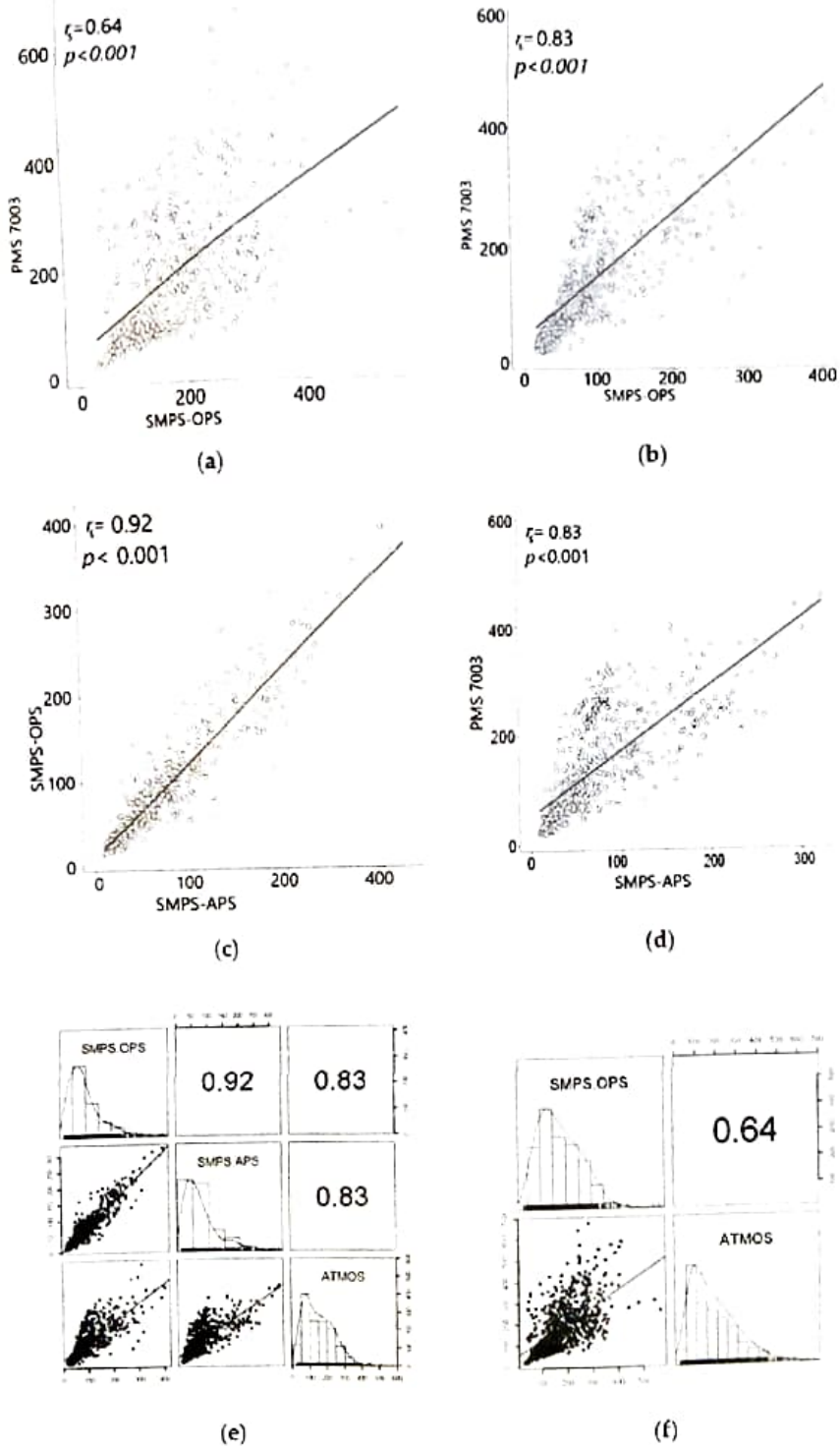

Figure 5. Scatter plots for measured PM_{10} between (**a**) SMPS–OPS and Atmos or PMS 7003 at the Indian Institute of Technology Delhi (IITD) site, (**b**) SMPS–OPS and PMS 7003, (**c**) SMPS–APS and SMPS–OPS, and (**d**) SMPS–APS and Atmos or PMS 7003 at the Manav Rachna International Institute of Research and Studies (MRIU) site, with their respective r_s and p-values, (**e**) pairwise correlation and data distribution of measured PM_{10} between SMPS–OPS, SMPS–APS, and Atmos at the MRIU site and (**f**) pairwise correlation and data distribution of SMPS–OPS and Atmos at the IITD site. The grey area along the black line represents the 95% confidence interval of regression. Numeric values in upper halves represent the Spearman's coefficients.

Additionally, SMPS–OPS and Atmos devices at both sites seem to appear strongly correlated. The main reason for using Spearman's correlation was due to skewed data obtained from the instruments used for PM_{10} measurements. Pearson's correlation method requires normal distribution as a preliminary condition to calculate an unbiased correlation. The correlation coefficient ($r_s \geq 0.64$) for each of the cases was observed to be quite high, which shows that there was a strong linear positive correlation. The observed findings suggest that OPS, also in combination with SMPS, acted well as the reference equipment. It may prove to be useful for developing countries' prospects in making portable and affordable PM sensors. Periodic calibration is recommended for these low-cost sensors, as suggested by Rai et al. [29]. However, a more profound statistical attempt considering confounders' effects on their measuring efficiency is required to ensure more confidence in such devices. The slopes and intercepts observed for the paired combinations in our study are shown in Table 1.

Table 1. Observed parameters for different pairwise Spearman's rank-order correlation among sampled datasets using various PM_{10} measuring instruments at two sites.

Instruments	MRIU			IITD		
	r_s	Slope	Intercept ($\mu g \cdot m^{-3}$)	r_s	Slope	Intercept ($\mu g \cdot m^{-3}$)
SMPS–OPS Vs. PMS7003	0.83	1.069	42.883	0.64	0.787	47.269
SMPS–APS Vs. SMPS–OPS	0.92	0.782	1.640	-	-	-
SMPS–APS Vs. PMS7003	0.83	1.188	53.396	-	-	-

The pairwise correlation among sampled PM_{10} datasets also showed only 1.64 $\mu g \cdot m^{-3}$ as intercept (for $r_s = 0.92$). These two datasets had nearly the same variation. Moreover, the parameters calculated from correlation analysis on the conducted experiments at two sites showed no significant change among them. However, local sources, including vehicular pollution nearby roads with other sources for re-suspension of dust, waste burning, several combustion sources, and secondary PM formation, are known to affect the PM-related parameters [55,57,58] routinely. Similarly, influencing factors like temperature, relative humidity, interference due to a light source, wind speed, and pressure likely bring variation in measurements.

The correlation observed between Atmos and reference instruments for measured $PM_{2.5}$ was better than that for PM_{10} (Supplementary Figure S3). Some of the recent papers from other countries have also shown that low-cost sensors' $PM_{2.5}$ matches more in comparison to PM_{10} [8]. In the case of $PM_{2.5}$ as well, we observed $p < 0.001$ for all four cases. This rejects the null hypothesis and suggests that there was a strong dependence between the sampled values and $PM_{2.5}$ measurements. Correlations ranging from results revealed that there was a strong linear positive correlation among the sampled datasets. The correlation between merged $PM_{2.5}$ concentrations for SMPS–APS and SMPS–OPS was found to be 0.95 (it was 0.91 in the case of PM_{10}) and between Atmos and research-grade instruments from 0.73 to 0.91. Since in the present study as well, the focus of the study was on the validation part of PM_{10} measurements by Atmos in measuring ambient concentration and to compare it with that of the accurate research-grade instruments, detailed information on $PM_{2.5}$ analysis is not presented. Nevertheless, wherever necessary, we have provided the illustrations as the supplementary files.

Furthermore, coarse PM or $PM_{2.5-10}$ (particle size between 2.5 and 10 μm) measured from Atmos devices at both the sites were compared along with the research-grade instruments at the respective sites. One time series of coarse PM for the whole duration and another time series with collocated time period with continuous period is presented in Supplementary Figure S4b. It was observed that the Atmos captured the coarse PM, which is comparable to the research-grade instruments, and the results were consistent for both the sites. The time series shows that the trends of the measured $PM_{2.5}$, $PM_{2.5-10}$, and PM_{10} from Atmos were comparable to that of the research-grade used in this study. The mean value of $PM_{2.5-10}$ measured from Atmos was 21.39 ± 12.55 $\mu g \cdot m^{-3}$ ($n = 702$) while that from SMPS–OPS and SMPS–APS were 25.52 ± 18.74 ($n = 940$) and 9.78 ± 7.10 ($n = 737$) $\mu g \cdot m^{-3}$, respectively. Similarly, in the case of IITD site, coarse particles measured using SMPS–OPS and Atmos were 64.67 ± 33.88 and

19.75 ± 14.88 μg·m^{-3}, respectively. Coarse PM data revealed that Atmos measurements underestimated the SMPS–OPS by 2.00 and 44.92 μg·m^{-3} at the MRIU and IITD sites, respectively, and overestimating the SMPS–APS by 24.80 μg·m^{-3}. We also found that there was a variability in the observed coarse fraction and the ratio of $PM_{2.5}$ to PM_{10} concentrations.

In the validation of the commodity PM sensors, a variety of reference methods were used. In our study, we did not validate our PM_{10} sensors to evaluate any reference methods. Instead, we looked for the suitability of the studied PM sensor. We also used available research-grade instruments that were considered as reference equipment to measure PM_{10}. For insight into the stability of Atmos devices, the heat map for the obtained R^2 was generated (Figure 6).

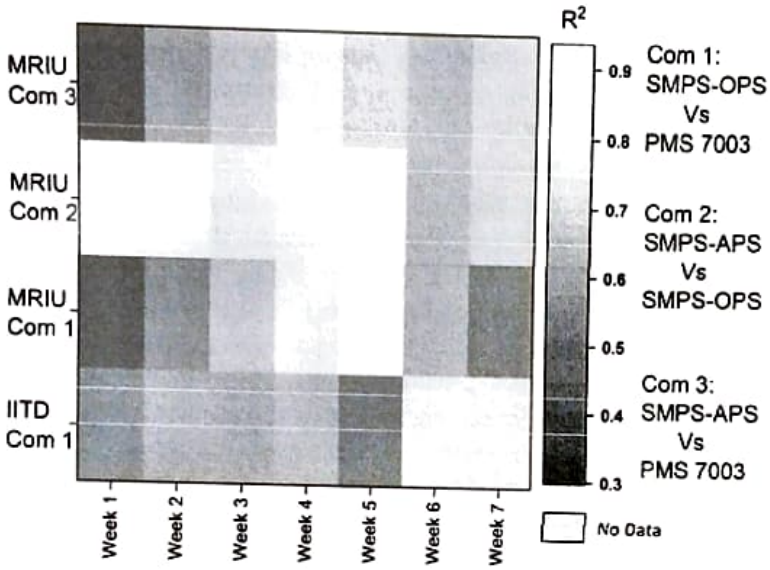

Figure 6. Heat map representing the coefficient of determinations (R^2) for weekly basis data between the different studied instruments during their field deployment of seven weeks. The different shades of blue color represent different R^2 values ranging from 0.3–0.9, and the yellow color describes that there was no data collected during the specific week.

The R^2 for each bivariate combination between the implemented PM measuring instruments for both the sites separately was determined weekly (week 1–week 7). The daily pattern of $PM_{2.5}$ is cyclic, and in our case, the PM_{10} measurement was conducted over a single season. It indicated that weekly data should be normally distributed. We, therefore, assumed that normality would prevail after classifying the data weekly. The agreement of the Atmos (Plantower PMS7003) with the SMPS–OPS and the SMPS–APS was observed to be moderate to high for different weeks from the seven-weeks-long field deployment (R^2 = 0.3–0.9). Therefore, a heat map with various shades of blue indicates the different coefficient of determinations observed from 0.3–0.9. Yellow represents the absence of data during the specific week for some of the combinations. The R^2 values observed between SMPS–APS and SMPS–OPS ranged from 0.6–0.9. Clearly, the R^2 between SMPS–APS and SMPS–OPS at the MRIU site was seen to be very high during the whole deployment.

The observed R^2 for the data collected during the six weeks between Atmos and SMPS–OPS at IITD were 0.43, 0.52, 0.56, 0.59, 0.43, and 0.81, respectively. The number of hourly data points varied in the seven weeks time period studied. Similarly, at MRIU for the same bivariate combination, the observed R^2 for consecutive weeks was 0.30, 0.45, 0.63, NA, 0.94, 0.58, and 0.44, respectively. On the other hand, with SMPS–APS as a reference for the comparative analysis of Atmos data, the observed R^2 for consecutive weeks were 0.32, 0.53, 0.63, NA, 0.68, 0.60, and 0.70, respectively. Mostly, the observed R^2 for the data was generally around 0.4–0.6, except for one week with a value as high as 0.9. The number of data points for PM_{10} in a week for IITD was 108–208, and that for MRIU was 22–173 with $p < 0.001$. We looked into the weekly-based data only to see the ranges of the R^2 between Atmos and reference.

However, there is more scope to be looked into while considering the reliability of Atmos in varying ambient PM_{10} concentration ranges. It includes the duration of data collection, the number of hourly data points, and impacting environmental parameters.

Similarly, at both the study sites, no specific diminishing concentrations were observed in the pattern of the R^2 values between Atmos PM sensors and reference instruments. The results, as mentioned above for different weekly PM sensor data, showed the correlations could go very high. Furthermore, it would improve by applying the correction factors.

The difference between the numbers of collected samples for hourly averaged PM_{10} concentrations can be attributed to the varying hourly averaged data points measured during the different weeks studied. The cause of variations in the ambient PM measurements may also include instrument contamination, hardware degradation, changed fan flow rates, and potentially insufficient cleaning of the sensors [46]. Zerrath et al. [27] investigated and described that the results of the OPS matched well with the APS and SMPS. However, their investigations focused primarily on the number of concentration and modes. For the variations between SMPS–APS and SMPS–OPS, Zerrath et al. [27] also showed that equivalent diameters of urban aerosol measured by OPS and APS might differ from each other in field conditions. Variations in correlation could be due to the presence of a difference in physicochemical properties, like the density of ambient particles in different environments.

The correlation between SMPS–OPS and SMPS–APS was observed to be very high for the MRIU site. Similarly, Szymanski et al. [59] and Hand and Kreidenweis [60] also demonstrated that SMPS–APS/OPS were comparable in their experiments. Data-driven analysis indicated that SMPS–APS and SMPS–OPS are very similar in PM_{10} measurements. Furthermore, the correlation coefficients for PMS7003 sensors with both devices exhibited similar values for MRIU, which reinforces the hypothesis. No specific difference in the patterns was observed due to the change in reference data as SMPS–OPS merged data instead of the SMPS–APS combination. In developing countries like India, there are large urban areas with less or no monitoring of air pollution [6,61]. As already discussed, most of the existing pollution monitoring instruments used are expensive, hence the extensive use of low-cost sensors for $PM_{2.5}$ and PM_{10} might be helpful in a better understanding of sources with high-resolution spatiotemporal data, along with the lesser number of monitoring stations equipped with reference-grade instruments. At the same time, big data generated from such a dense network of low-cost sensors might provide crucial information and also an opportunity for exploring further research aspects.

Additionally, seven-weeks-long data might not be sufficient to conclude the existence of drifts in the sensor measurements. For understanding the impacts of time on the performance of Atmos, a study over a longer duration of field deployment period is required. Johnson et al. [23] also mentioned that the actual response of light scattering-based PM sensors is predominantly a function of the ambient aerosol features varying with the site. Clearly, in the case of PM sensors, there is a need to explore further its size distribution and chemical composition. The envisioned better prospect of extensively available PM sensors hinges on data reliability. Hence, some of the limitations are collectively described in the subsequent section.

Limitations of the study: Like most of research studies, this study also has certain limitations, which are described below:

- A comparison of identical sensors generally revealed the highest agreement. Nevertheless, attempting more statistical analyses might have thrown light onto the cause of even the very slight variations among them. Accessory measurements indicating ambient temperature, humidity, and aerosol refractive index were not included in this study. The optics-based detection of particulates is probably affected by relative humidity. The uptake of moisture by hygroscopic particulates leads to increased scattered light signals. An attempt to calibrate these Atmos devices, especially for PM_{10} measurements with longer deployment duration, may help to explore more potential impacts from the variables such as relative humidity and temperature;

- Among the limitations of the study, lower and upper detection limits are also an expected factor in sensor performance not considered in this case. Hence, to ensure complete accuracy, the PM sensors need to be deployed in the environments where they can be tested for its performance at extreme extents. A longer duration of PM sensor deployment featuring high and low concentrations would be a challenge;
- Data from research-grade adjacent instruments (SMPS–APS and SMPS–OPS) were proven as suitable for PM measurements. However, to the best of our knowledge, no previous study using these instruments for similar applications is available. Hence, we suggest looking deeper into the data accuracy and uncertainties from these instruments as well as those being used as references;
- Transparency remained an issue with the many sensor developers where algorithms applied are valuable intellectual property. Developers and researchers should explicitly document independent algorithms to put faith in air sensor data. Hagler et al. [13] have also reported that trust in the developed sensors could augment when manufacturers would share which factors they integrated while post-processing the raw data;
- Likewise, most of the other available PM sensors studied Plantower PMS7003 also had no inertial-based size cuts preventing large particles from moving towards the optical chamber. It is therefore expected that it might affect the precision of readings to some extent as well. The limitations of this study also act as points to be considered as the future scope that may further serve with more information.

4. Conclusions

The data-driven assessment of our custom-designed sensors elucidated scopes where further advancement in its research and development can be crucial. We emphasized inter-comparison of low-cost PM sensors in the polluted sites in Delhi-NCR. The performance of PM sensors was consistent, as tested by their R^2. The trends of PM_{10}, $PM_{2.5}$, and $PM_{2.5\text{-}10}$ measurements from Atmos devices matched well with research-grade monitors. The uncorrected PM_{10} measurements by low-cost PM sensors exhibited a strong correlation with merged PM_{10} concentrations from SMPS–APS and SMPS–OPS. The Atmos devices appeared promising for PM_{10} measurement applications. Results also showed that the un-corrected PM sensors displayed consistent performance (with $0.64 \leq r_s \leq 0.83$) for PM_{10} data acquired from the research-grade instruments. During the campaign, a sufficiently high R^2 value was observed between PM_{10} measured by Atmos and research-grade instruments, which also validates the sensors' data quality.

The weekly separation of data and the regression test implies that the Atmos devices could estimate the PM_{10} level very well. In some cases, for particular instances, $R^2 > 0.7$ was observed between the devices. The few inconsistencies where data were sufficient but the device performance was poor remain a subject of further study. Applying a calibration equation or the correction factor should improve the sensor performance for real-time ambient PM_{10} measurements.

Supplementary Materials: The following are available online at http://www.mdpi.com/1424-8220/20/5/1347/s1, Figure S1: Time series of ambient $PM_{2.5}$ concentrations ($\mu g \cdot m^{-3}$) data collected from Atmos PMS7003 sensor and reference instruments (merged $PM_{2.5}$ from SPMP-OPS and SMPS-APS) during the deployment period at (**a**) Manav Rachna International Institute of Research and Studies, Faridabad (MRIU) and (**b**) Indian Institute of Technology Delhi (IITD) monitoring sites., Figure S2: (**a–c**) from left to right represents Quantile-Quantile (QQ)-plots for measured PM_{10} from merged SMPS–APS, merged SMPS–OPS, and un-calibrated Plantower PMS7003 sensor, respectively at Manav Rachna International Institute of Research and Studies, Faridabad (MRIU) and (**d,e**) represents the QQ-plots for merged SMPS–OPS and un-calibrated PMS7003 from Indian Institute of Technology Delhi (IITD), respectively., Figure S3: (**a–d**) Scatter plots for measured $PM_{2.5}$ between (**a**) SMPS-OPS and Atmos at Indian Institute of Technology Delhi (IITD) and Manav Rachna International Institute of Research and Studies, Faridabad (MRIU) between, (**b**) SMPS–OPS and PMS 7003, (**c**) SMPS–APS and SMPS–OPS, and (**d**) SMPS–APS and Atmos, respectively with their respective r_s and p-values, (**e**) pairwise correlation and data distribution of measured $PM_{2.5}$ between SMPS–OPS, SMPS–APS, and Atmos at MRIU site, and (**f**) pairwise correlation and data distribution of SMPS–OPS and Atmos at IITD site. The grey area along the black line represents the 95% confidence interval of regression. Numeric values in upper halves represent the Spearman's coefficients., Figure S4: Time series of coarse particle $PM_{2.5\text{-}10}$ measured from merged SMPS–APS, merged

SMPS–OPS, and Atmos at (**a**) Manav Rachna International Institute of Research and Studies, Faridabad (MRIU), Faridabad during the whole study period and (**b**) for a small section of time series with common collocated data points.

Author Contributions: Writing—original draft preparation and writing—review and editing, investigation, R.S. (Ravi Sahu); conceptualization, supervision, project administration, funding acquisition, resources, S.N.T., methodology and data curation, P.K. and S.M.; writing—review and editing, A.K.S.; software, writing—review and editing, R.S. (Ronak Sutaria); investigation, validation, formal analysis, writing—original draft preparation, K.K.D.; resources, S.T.; All authors have read and agreed to the published version of the manuscript.

Funding: The APC for this research was funded by the Indo-United States Science and Technology Forum (IUSSTF), Ref: IUSSTF/WAQM-Air Quality Project-IIT Kanpur/2017.

Acknowledgments: This research is supported under the Research Initiative for Real-time River Water and Air Quality Monitoring program funded by the Department of Science and Technology, Govt. of India (DST) and Intel®, and administered by the Indo-United States Science and Technology Forum (IUSSTF).

Conflicts of Interest: The authors declare no conflict of interest.

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GOVERNMENT OF GOA

DIRECTORATE OF MINES & GEOLOGY

Sub :-E-Auction Procedure 2023 (29th e-auction)

The procedure for e-auctioning the extracted iron ore (herein after termed as 'cargo') lying at various locations in the State,

1. The iron ore (herein after termed as 'cargo') that is being auctioned is on as is where is basis lying on the jetties or within the erstwhile mining leases or on the plots other than jetties/erstwhile mining leases. The cargo that is being auctioned may be in the form of fines, lumps and ROM or a mixture of the same.
2. The e-auction will take place on MSTC platform.
3. It will be a single stage forward auction.
4. All payments shall be done on MSTC portal only. Only upon receipt of the confirmation from MSTC that all the payments have been received from the winning bidder, the said winning bidder will be declared as successful bidder by DMG
5. Only an end-user or an exporter is eligible to participate in the e-auction.
6. The cargo purchased in the e-auction by the end-user must be utilized for domestic consumption only. No intermediate sale is permitted.
7. The cargo won in the e-auction by the exporter shall be compulsorily exported. No intermediate sale is permitted.
8. The cargo won in the e-auction by the end-user cannot be diverted for export and vice versa.
9. However, if the bidder is both end-user as well as exporter then he is permitted to use the cargo for both end-use as well as export.
10. The cargo won in the e-auction by an end-user or an exporter shall be transported from the primary location of e-auction within 90 days of declaration of winning bidder as

the successful bidder by the DMG. However, this 90 days' period doesn't include the 'no transportation' period from 7th June to 2nd September.

11. The end-user who won the cargo in the e-auction on any location shall transport the cargo by taking transit permit from the DMG within 90 days from the date of declaration of winning bidder as successful bidder by the DMG.

12. If the cargo won by the exporter in the e-auction is within the erstwhile mining lease or on the plots, then same shall be transported to another location of the exporter within 90 days of declaration of exporter as the successful bidder. However, in case the cargo won by the exporter is at the jetty point then the exporter shall transport the said cargo either exporting it directly or transporting it to another location within 90 days of declaration of the exporter as successful bidder. If the exporter wants to directly export from the jetty point, then the exporter is only eligible for export permit from DMG and such an export shall be done by the exporter within 90 days of declaration as successful bidder. If the exporter who is the successful bidder wants to shift the cargo to another location, then the exporter shall take transit permit from DMG and transport the cargo within 90 days of declaration of the exporter as successful bidder.

13. Screening and processing of ROM at the primary location is permitted subject to the condition that the winning bidder shall take all necessary approvals as may be required from the competent authorities including DMG before actually undertaking screening and crushing at its own risk and responsibility. After screening and crushing the winning bidder shall report to the DMG the quantity and type of processed ore for inspection by DMG and taking its stock on Bhumija portal for issuing transit permit. However, in such cases the 90 days' period for transportation of cargo from the primary location shall include the screening and processing time.

14. The cargo proposed for e-auction will be in the form of lots along with lump sum base price (herein after called as 'the base price') as given in Annexure-1. Each lot may have different stacks with indicative quantity and Fe grade as available in the records of DMG as declared by the erstwhile lessees. All the stacks at one location are clubbed as one lot. The base price and Fe grade of each lot is estimated based on Average Sale Price of IBM. The DMG shall not take the responsibility of quantity and quality of

cargo of any lot or any stack within the lot. It shall be the responsibility of the bidder to visit the location of the cargo and make own assessment of quantity and quality of the cargo put for auction. The interested bidders shall be permitted to visit the location of cargo and is allowed to take not more than one sample of 100 grams each from each stack within the lot in the presence of officials of DMG. For instance, if a lot has 5 stacks, then the interested bidder is allowed to take one sample of 100 gm each from the 5 stacks in that lot. The last date for visiting the location of cargo and taking sample is given in the bid schedule at the end of this document. Any interested bidder purchases this document after the last date for visiting the location of cargo and taking sample, then he/she is not entitled to visit the location of the cargo and take sample.

15. In case the quantity of cargo in the auctioned lot won by the successful bidder is more than the quantity indicated in the Annexure-1 then the successful bidder is entitled to transport the cargo only to the extent the quantity put for the bid and no additional quantity shall be allotted to the successful bidder. In case the quantity of cargo in the auctioned lot won by the successful bidder is less than the quantity put for the bid as per Annexure-1 then the successful bidder is neither entitled for any refund of bid amount towards shortage in quantity nor is entitled for some other cargo from another location.

16. The auction will take place on MSTC platform. The interested bidders need to register with MSTC to participate in the auction. The process will comprise single stage forward auction with the base price for each lot as indicated in the Annexure-1. The initial auction window will be of two hours, beyond which there will be an incremental provision of 8 minutes if the time lag between two bids is less than 8 minutes. Minimum increment allowed in the bid is Rs.1000 or multiples thereof. For instance, if the lump sum base price is Rs. 50,000 the next bid may be increased to Rs. 51,000; Rs. 52,000 and so on. The bid schedule will be declared on MSTC portal.

17. For participation in the auction the interested bidder shall register on MSTC portal.

18. The interested bidders need to make payment of pre-bid EMD, which is 2% of the bid value (i.e. base price) for each lot. The date on which the auction of each lot is completed is considered as the auction conclusion date for that particular lot. The pre-

bid EMD of all the unsuccessful bidders will be refunded. The winning bidder need to pay post-bid EMD of 25% of the bid value (i.e. the highest bid price quoted by the winning bidder in the e-auction) within 48 hours of conclusion of e-auction (the 48-hour period shall exclude bank holidays). The entire amount of bid value along with royalty, GST etc. shall be paid within 30 days of the auction conclusion date for each lot.

19. An illustrative example of making payment by the winning bidder is as follows. (Say quantity 1000 tonnes)

1. Winning bid value (say)	:	Rs. 1,00,000
2. SGST 9%	:	Rs. 9,000
3. CGST 9%	:	Rs. 9,000
(In case of IGST 18% : Rs. 18,000)		
4. Royalty 15%	:	Rs. 15,000
5. Total invoice value (1+2+3+4)	:	Rs. 1,33,000
6. TCS on invoice value (1%)	:	Rs. 1,330
7. TCS on Royalty (2%)	:	Rs. 300
8. Processing fees (Rs.1 per ton)	:	Rs. 1,000
9. MSTC service charges (0.2%) of sale value	:	Rs. 200
10. 18% IGST on Sl. No. 9	:	Rs. 36
(Tax rates are indicative subject to change if any)		

Total amount payable to DMG (5+6+7+8+9): Rs. 1,35,866

All the above payment is to be done on MSTC portal only. (In each case, payment in respect of 4, 6, 8, 9 and 10 will be worked out by DMG and informed to MSTC).

20. In case the winning bidder fails to pay the post-bid EMD within 48 hours then the pre-bid EMD of the winning bidder stands forfeited.

21. Upon making payment of post-bid EMD, if the winning bidder fails to make the full payment within 30 days of the auction conclusion date for each lot then the post-bid

EMD of the winning bidder shall stand automatically forfeited without any further notice to the winning bidder in this regard.

22. The winning bidder will be declared as successful bidder by the DMG upon receipt of confirmation from MSTC to DMG that the winning bidder has made the payment of 100% amount including taxes. The intimation regarding successful bidder will be sent to the winning bidder by e-mail by the DMG for lifting of the cargo within 90 days indicating the last date for lifting the cargo. In case the 90th day is a Saturday or Sunday or any other public holiday then the next Government working day will be considered as the last day for lifting the cargo.

23. In case the successful bidder fails to lift the cargo from the erstwhile mining lease or plot or from the jetty point within 90 days' of declaration of the winning bidder as the successful bidder by the DMG then both the cargo and the entire amount paid to the DMG stands forfeited without any further notice to be given by the DMG to the successful bidder for the same.

24. Any deviation in the e-action procedure before the conclusion of e-auction process shall require prior approval of the Government, which shall be notified to all the interested bidders through the MSTC portal.

25. The Government reserves the right to notify any deviation/changes in the auction procedure suo-moto without giving any reasons.

26. No deviation in the e-auction procedure shall be considered after conclusion of the e-auction process, save in unforeseen circumstances like act of God, flood, pandemic, earth quake etc. Any change in duty/tax structure or price fluctuations in the domestic and/or international market shall not be considered as unforeseen circumstance.

27. The decision of the Government with regard to the treatment during unforeseen circumstances shall be final and binding on the successful bidder.

28. The Government reserves the right to annul the entire auction process at any point of time without assigning any reason and in such an event the interested bidders cannot claim any amount of whatsoever towards expenditure incurred by them if any.

Auction Schedule

1. Last date for site visit for self-assessment of quantity and quality of cargo and taking sample: 25-9-9-2023 (Monday)
2. Lot-wise auction schedule

   (a) 4-10-2023 (Wednesday) : Lot No. 1 to 8 (8 lots)

   (b) 5-10-2023 (Thursday) : Lot No. 9 to 15 (7 lots)

   (c) 6-10-2023 (Friday) : Lota No. 16 to 22 (7 lots)

Article published in 'The Goan' newspaper, dt. 14th April

THE GOAN
SUNDAY APRIL 14, 2024 | 16 pages | PRICE ₹ 10 | PANAJI | MARGAO | GOA | VOLUME 13, NO 297
EVERYDAY

Soon, new tech to check air quality on mining routes

THE GOAN | NETWORK

PANAJI

As iron ore mining activities commence at Bicholim after a gap of over six years, the Goa State Pollution Control Board (GSPCB) in a major move has decided to do away with the conventional or manual method of air monitoring along the ore transportation routes.

The Board is set to install Continuous Online Ambient Air Quality Monitoring Stations (COAAQMS) along the 23 iron ore transportation routes across North and South Goa to measure parameters like Particulate Matter (PM10), PM 2.5, Nitrogen dioxide and sulfur dioxide.

BREATHING EASY: CLEAN AND FRESH AIR

- GSPCB to install Continuous Online Ambient Air Quality Monitoring Stations along 23 iron ore transportation routes across North and South
- Parameters like Particulate Matter (PM10), PM 2.5, nitrogen dioxide and sulfur dioxide to be measured
- Monitoring to be carried out in compliance with guidelines issued by CPCB and Revised Ambient Air Quality Standards
- Currently, monitoring is conducted through manual method
- Under continuous method, automatic real-time data collection is done
- Board feels conventional method along mining belt will not help monitor dust pollution
- All mining sites to be monitored so that Board gets data of air quality when mining is in operation and when it is shut

The online ambient air quality monitoring will be carried out in compliance with the guidelines issued by the Central Pollution Control Board (CPCB) and the Revised Ambient Air Quality Standards notified in November 2009, sources said.

Currently, the ambient air quality monitoring is conducted through a manual method-analysis of pollutants measured once every six days where data is transferred manually.

Under the continuous method, automatic real-time data collection of pollutants measured is done.

Sources informed that the Board is of the clear view that the Conventional method of air monitoring along the mining belt will not serve the exact purpose of monitoring the dust pollution along these routes, which are also under the scanner of the Bombay High Court at Goa.

Sources said that the Board members, during its recent meeting, decided to monitor air quality at all mining transportation sites so that Board gets data of air quality when

›Continued on P6

Soon, new tech to check air quality on mining routes

mining is in operation and when it is shut. "Only COAAQMS will provide effective surveillance and data of dust pollution in mining areas for necessary action," sources said adding that the installation will be completed before commencement of fresh ore transportation. "If we witness air pollution during transportation of ore, we will immediately direct the authorities to bring it under control or stop the transportation," sources said. Mining in Goa came to a halt in March 2018 after the Supreme Court quashed the second renewal of 88 mining leases. However, the transportation of e-auctioned ore continued along certain mining routes.

Now, with M/s Vedanta Limited commencing fresh mining activities at its Bicholim Mineral Block, heavy vehicle movement is expected to increase. Manual monitors to measure air quality have been used since 1984-85 by the Central Pollution Control Board (CPCB), which was later renamed the National Air Quality Monitoring Programme (NAMP) network.

ISSN: 0974 - 0376

The Ecoscan : Special issue, Vol. IX: 731-736: 2016
AN INTERNATIONAL QUARTERLY JOURNAL OF ENVIRONMENTAL SCIENCES
www.theecoscan.com

THE SPATIAL CHARACTERISTICS AND HEALTH IMPACTS OF PARTICULATE MATTERS IN MINING REGION OF NORTH GOA

Gurdeep Singh and Atahar Perwez

KEYWORDS

Air pollution
Mining
Particulate matter
Health impact

Proceedings of National Conference on Harmony with Nature in Context of Resource Conservation and Climate Change
(HARMONY - 2016)
October 22 - 24, 2016, Hazaribag,
organized by
Department of Zoology, Botany, Biotechnology & Geology
Vinoba Bhave University,
Hazaribag (Jharkhand) 825301
in association with
NATIONAL ENVIRONMENTALISTS ASSOCIATION, INDIA
www.neaindia.org

The Ecoscan
AN INTERNATIONAL QUARTERLY JOURNAL OF ENVIRONMENTAL SCIENCES

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ABSTRACT

Iron ore mining is a major economic activity in Goa. However, over the recent past years Goa had faced a hugeclamor against the worsened level of pollution due to rampant mining activities and resulting into a complete halt on mining activities.In order to estimate the impact of particulate pollution on human health, health impact assessment was done using the average concentration of PM_{10} and $PM_{2.5}$ in the iron ore mining region of north Goa. The average concentration levels of PM_{10} and $PM_{2.5}$ in the study area were observed 170$\mu g/m^3$ and 82 $\mu g/m^3$, respectively, which are beyond the NAAQS as prescribed by CPCB by the factor of 1.7 and 1.4. Transportation routes were found most polluted with the concentrations of PM_{10} and $PM_{2.5}$ as 227 $\mu g/m^3$ and 116 $\mu g/m^3$, respectively. From the observation of health impact assessment, maximum number of premature mortality cases (1266) were found to be associated with $PM_{2.5}$, while PM_{10} was associated with maximum number of cases of cardiovascular diseases, respiratory diseases and chronic bronchitis. The number of cases of chronic bronchitis were over whelmingly larger than other health endpoints implying that reducing PM_{10} and $PM_{2.5}$ concentration would gain significant benefit from avoiding chronic bronchitis.

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INTRODUCTION

Mining is among the eight core industries in India andhas a significantimpactonthe national economy.In addition, it also facilitates the growth of other core industries, which, in turn, are critical for the overall economic development.However, mining activities also have detrimental impacts on the environment (Singh and Perwez, 2015a).Therefore, it is imperative for any nation to promote mining while ensuring that environmental conditions meet quality standards. Major air pollutants emitted from mining operations are TSP and PM_{10} (Chakraborty *et al.*, 2002). The deterioration in air quality is most severe in open-pit mining regions. The primary sources of atmospheric particulates (PM) from mining activities include removal of overburden, excavation, vehicular movement on the haul roads, loading and unloading of the overburdenas well as ores(Singh and Perwez, 2015b). These atmospheric particulatesdegradethe quality of ambient air and also decrease the visibility to a significant extent (Xue *et al.*, 2015). The effects on the global radiative balance (Watson, 2002) and its role in climate change (IPCC, 2001) are also other important aspects of interest on PM.

Air pollution has emerged as the most critical problem of the century (Kumar *et al.*, 2011). The current interest in atmospheric particulate matters (PM) is mainly due to its effect on human health (Pope *et al.*, 2002). It is closely associated with increases in morbidity and mortality (Maier *et al.*, 2008; Abbas *et al.*, 2009). PMs consist a variety of components such as trace elements, organic compounds, acids, soil and dust (Rai and Panda, 2014). Trace elements are severely toxic to humans because of their tendency of bio accumulation in the biological system (Du *et al.*, 2013) especially, in the fatty tissues. It is found in almost all atmospheric aerosol size fractions and in general, fine PM carries a higher burden of toxic elements than does coarse PM (Fang *et al.*, 2000). Trace elements associated with respirable particles have been observed to increase lung and cardiopulmonary injuries in humans (Shaheen *et al.*, 2005).Several organic components of PM (polycyclic aromatic hydrocarbons (PAHs)) are labelled as carcinogenic (Pedersen *et al.*, 2006).

Adverse health impacts associated with $PM_{10}$is well documented (Zeger *et al.*, 2008; Mitchell *et al.*, 2010).It impairs respiratory system (Hansard *et al.*, 2011), cause inflammation and diminish pulmonary function (Maher *et al.*, 2008). Fine particulates ($PM_{2.5}$) are even more deleterious in terms of health impacts because they can penetrate deeper into the lungs alveoli (Saragnese et al., 2011). Links with lung cancer (Pope *et al.*, 2002) and increased cardiovascular mortality rates (Schwartz, 1996) have also been established.

Goa is one of the smallest states of India and is endowed with a number of mineral resources of economic importance. Itis an important iron and manganese ore producing State in the Country.The rampant mining over the region had exacerbated the level of particulate pollution to a critical level, resulting into a complete halt on mining activities by the order of Honorable Supreme Court of India in October, 2012. The concern about environmental quality in this region is due the high ecological significance of the region, its scenic beauty and an important tourist destination (Singh *et al.*, 2015). In order to develop an abatement

plan for the region to control the pollution levels within the desire limits, an assessment of existing scenario is vital. Hence, the present study was emphasized to estimate the concentrations of PM_{10} and $PM_{2.5}$ in iron ore mining region of North Goa. It also dealt the health impacts associated with these atmospheric particulates.

MATERIALS AND METHODS

Study area

North Goa is one of the two districts that make up the State of Goa. The district has an area of 1736 km². North Goa is bounded by Sindhudurg and Kolhapur districts of Maharashtra state to the north and east respectively, by South Goa District to the south, and by the Arabian Sea to the west. The study area comprising 570.63 Km² (latitude of 15°24′ to 15°41′N and longitude of 73°49′E to 74°13′E). In order to provide more focus on the key theme of regional impacts of mining and ancillary infrastructures on the pristine environmental setting, the study area has been broadly divided into; Core Zone (wherein all the core mining activities in North Goa are located along with adjoining 1 km belt), Buffer Zone (encompassing additional 4 km around the core zone) and ore transportation routes. Seventeen (17) representative ambient air quality monitoring stations were selected as per selection criteria provided in IS: 5182 Part XIV (BIS, 2000) for systematic ambient air quality monitoring. In order to emphasize the sources responsible for pollution, four stations were selected around mines, seven in the buffer zone and remaining six along ore transportation routes as depicted in Table 1 and Fig. 1.

The study was carried out during the summer season (represented by April, May and June) in 2013. 24 hourly ambient air samples were collected on twice a week basis. PM_{10} samples were collected, using respirable dust sampler (Envirotech APM 460 NL) (flow rate of 1.1 m^3min^{-1}) on Whatman glass fiber filters (20.4 cm x 25.5 cm) (IS 5182 Part 23, 2006) and $PM_{2.5}$ samples were collected, using fine particulate sampler (Envirotech APM 550 MFC) (flow rate 16.7 LPM) on PTEF filter paper (47 mm diameters) (CARB, 2002). Filter papers were properly inspected for damage using a light table before use. After inspection, the filter papers were conditioned in the desiccator, 24 hours before sampling and kept 24 hours after sampling. The differences in the weight of the filters before and after sampling (using an electronic microbalance (AND HR-200)were used to calculate PM_{10} and $PM_{2.5}$ concentrations.

Health Impact Assessment

The health impact assessment is widely used tool to quantify the hazards associated with air pollution (Huang and Zhang, 2013; Dias *et al.*, 2012; Matus *et al.*, 2012). For this study, health impact of airborne PM_{10} and $PM_{2.5}$ was assessed by using exposure response functions, as described by Cheng *et al.*(2013), Song *et al.* (2016) and the World Bank (2007). The primary assumption of this method is that, if the concentration of pollutant exceeds beyond the threshold, the risk by 1 $\mu g/m^3$ increment can be calculated based on an epidemiological coefficient for one person. If we know the population of an area, we can estimate the health impact for the whole area.

In this study four health endpoints associated with PM_{10} and $PM_{2.5}$ exposure (mortality, respiratory diseases, cardiovascular diseases and chronic bronchitis) were examined. The relative risk (RR) for the health outcomes were calculated using Equation (1):

$$RR = \exp[\beta * (C - Co)] \quad (1)$$

Where,

C is the average PM_{10} and $PM_{2.5}$ concentration, and C_0 is the reference. Here, C_0 values for PM_{10} and $PM_{2.5}$ were considered as 20 $\mu g/m^3$ and 10 $\mu g/m^3$ (WHO, 2005). âis the empirical coefficient (percentage increase in health effect per 1 $\mu g/m^3$ increment in concentrations. The values of âfor the four endpoints are listed in Table 2.

The number of cases for each endpoint (E) attributed to PM_{10} and $PM_{2.5}$ was calculated by multiplying the population (P) by the difference in the current incident rate (f_p) and the incidence rate in a clean environment (f_0) using Equation (2).

$$E = P * (f_p - f_o) \quad (2)$$

The current incident rate (f_p) was calculated by multiplying the incidence rate in a clean environment (f_0) by the relative risk (RR), using Equation(3). For this study the values of f_0 for each endpoint were taken from Song et al. (2016).

$$F_p = f_o * RR \quad (3)$$

By substituting Equation (3) into Equation (2), we obtained the value of E ((Equation (4)).

$$E = (RR - 1) / RR) * f_p * p \quad (4)$$

RESULTS AND DISCUSSION

Spatial distribution of PM

The average concentrations of PM_{10} and $PM_{2.5}$ (Table 3) during the period of observationin the study area were observed 170 $\mu g/m^3$ and 82 $\mu g/m^3$, respectively, which is 1.7 and 1.4 times the National Ambient Air Quality Standards (NAAQS) prescribed by Central Pollution Control Board (CPCB, 2009). Careful observation of the results reveals an apparent spatial

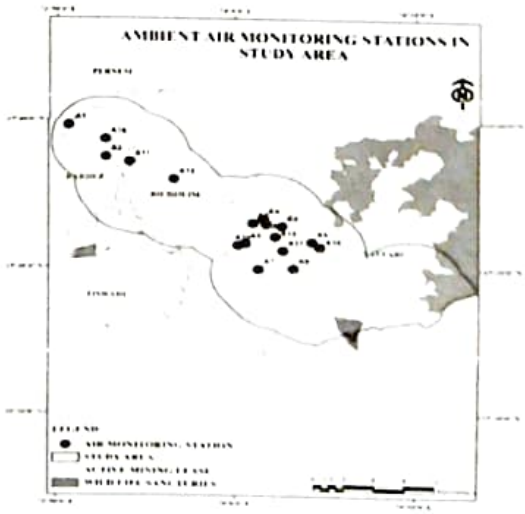

Figure 1: Ambient air quality monitoring stations in the study area

Table 1: Ambient air quality (AAQ) monitoring stations in the study area

Monitoring Stations	Code	Name	Location Latitude (N)	Longitude (E)
Mines	A14	Pissurlem Mine	15°31'24.8"	74°04'42.1"
	A15	Harvalem Mine	15°32'56.1"	74°01'44.3"
	A16	Adwalpal Mine	15°38'40.7"	73°52'45.1"
	A17	Velguem - Surla Mines	15°31'08.4"	74°2'38.3"
Buffer Zone	A1	Revora Village	15°39'35.8"	73°50'41.2"
	A2	Tivim Village	15°37'27.7"	73°52'46.3"
	A4	Harvelem Village	15°33'18.1"	74°01'33.1"
	A7	Surla Village	15°29'53"	74°01'17.4"
	A8	Honda Village	15°32'48.6"	74°02'35.7"
	A9	Velguem Village	15°29'56.6"	74°03'13.4"
	A11	Assanora Village	15°37'09.0"	73°54'06.1"
Ore Transportation Routes	A3	Cudnem Village	15°33'01.0"	74°00'59.6"
	A5	Pissurlem Village	15°31'45.4"	74°01'33.1"
	A10	Navelim	15°31'37.3"	74°00'33.4"
	A6	Amona Village	15°31'29.3"	74°00'08.9"
	A12	Bicholim Town	15°35'57.9"	73°56'34.58"
	A13	Sonshi Village	15°32'5.4"	74°02'13.2"

Table 2: Concentration-response empirical coefficients for the four health endpoints

Health endpoints	Empirical coefficient â (95% confidence interval) PM_{10}*	$PM_{2.5}$**
Mortality	0.00038 (0.00035, 0.00042)	0.00336 (0.00076, 0.00504)
Cardiovascular Disease	0.00066 (0.00036, 0.00095)	0.00068 (0.00043, 0.00093)
Respiratory Disease	0.00124 (0.00084, 0.00162)	0.00109 (0, 0.00221)
Chronic Bronchitis	0.00656 (0.00238, 0.01013)	0.01009 (0.00366, 0.01559)

*Peng et al. (2009), Guo et al. (2009), Huang and Zhang (2013), Xu et al. (2014)**Aunan and Pan (2004), Song et al. (2016)

Table 3: Spatial variation in concentrations of PM_{10} and $PM_{2.5}$ ($\mu g/m^3$) in the study area

Monitoring Stations		Average ± Std. Dev.	Standard (NAAQS, 2009)	Exceedance Factor (EF)	Average ± Std. Dev.	Standard (NAAQS, 2009)	Exceedance Factor (EF)	$PM_{2.5}/PM_{10}$ ratio
Mines	A14	159±27	100	1.6	72±19	60	1.2	0.45
	A15	157±13	100	1.6	67±9	60	1.1	0.43
	A16	136±22	100	1.4	56±10	60	0.9	0.41
	A17	116±5	100	1.2	52±3	60	0.9	0.45
Buffer Zone	A1	113±6	100	1.1	52±5	60	0.9	0.46
	A2	129±17	100	1.3	62±6	60	1.0	0.48
	A4	120±15	100	1.2	59±8	60	1.0	0.49
	A7	165±29	100	1.6	80±20	60	1.3	0.48
	A8	162±17	100	1.6	75±15	60	1.3	0.46
	A9	137±16	100	1.4	59±7	60	1.0	0.43
	A11	135±22	100	1.3	66±11	60	1.1	0.49
Ore Transportation Routes	A3	232±18	100	2.3	114±13	60	1.9	0.49
	A5	172±20	100	1.7	92±10	60	1.5	0.53
	A10	220±21	100	2.2	112±21	60	1.9	0.51
	A6	263±48	100	2.6	130±23	60	2.2	0.49
	A12	197±12	100	2.0	103±7	60	1.7	0.52
	A13	276±36	100	2.8	147±20	60	2.4	0.53

variation in concentration levels. Highest concentration of PM_{10} was observed along the ore transportation routes (227 $\mu g/m^3$), followed by mines (142 $\mu g/m^3$) and buffer zone (137 $\mu g/m^3$). However, $PM_{2.5}$ concentration was found highest along the ore transportation routes (116 $\mu g/m^3$), followed by buffer zone (65 $\mu g/m^3$) and mines (62 $\mu g/m^3$). The exceedance factor (EF) calculated by dividing the average concentration by the desired limit (NAAQS) also evidenced the exaggeration of PM concentrations along the ore transportation routes, especially, of PM_{10}. The EF of PM_{10} along the ore transportation routes was observed highest (2.3) followed by buffer zone and mines (1.4 each). Among the stations situated along the ore transportation routes, A13 (Sonshi Village) and A6 (Amona Village) were observed with highest EF (2.8 and 2.6, respectively), which is due to very intense traffic of ore carrying dumpers in addition to the public traffic. The EF of $PM_{2.5}$ was also observed highest along the ore transportation routes (1.9),

Table 4: The number of cases for each health endpoint attributed toPM_{10} and $PM_{2.5}$in North Goa

Health Endpoints	PM_{10}	$PM_{2.5}$
Mortality	326 (301-360)	1266 (314-1792)
Cardiovascular Disease	424 (236-597)	215 (137-291)
Respiratory Disease	1434 (1000-1823)	638 (0-1243)
Chronic Bronchitis	3927 (1883-4899)	3238 (1453-4230)

followed by buffer zone (1.1) and mines (1), which are slight lower than the exceedance factors of PM_{10}. However, the dominance of $PM_{2.5}$ along the ore transportation routes is apparent from the $PM_{2.5}/PM_{10}$ratios, which were greater than at 66.6% stations (four out of six) with an average of 0.51. This indicates that the contributions of $PM_{2.5}$ to the total PM_{10} is high (Tiwari *et al.*, 2015) along the ore transportation routes. High contribution of $PM_{2.5}$ to the total PM_{10} is the indication of dominance of tail pipe emission and secondary particulate formation to the total emission in comparison to the resuspension of road dusts.The ratios of $PM_{2.5}/PM_{10}$ in mines and buffer zone were observed as 0.43 and 0.47, respectively.Thisshows the dominance of coarser particles. Tecer et al. (2008) also reported the dominance of coarse PM fraction in opencast mines in all climatic conditions.

Health impacts due to PM_{10} and$PM_{2.5}$ levels

Similar kind of study was performed by Song et *al.* (2016) in China to estimate the health impacts of ambient fine particulates ($PM_{2.5}$) considering health endpoints.The four health endpoints associated with PM_{10} and$PM_{2.5}$exposures are presented in Table 4.It can be seen that about 326 (301-360) premature mortality, 424 (236-597) cases of cardiovascular diseases, 1434 (1000-1823) cases of respiratory diseases and 3,927 (1883-4899) cases of chronic bronchitis, can be attributed to PM_{10} pollution.The number of cases of premature mortality, cardiovascular diseases, respiratory diseases and chronic bronchitis attributed to $PM_{2.5}$ pollution can be 1266 (314-1792), 215 (137-291), 638 (0-1243) and 3238 (1453-4230), respectivelyin North Goa district. It is clearly apparent that, the number of cases of premature mortality is about four times higher for $PM_{2.5}$ than that of PM_{10}, which can be attributed to the ability of fine particles to get deposited deeper into the alveoli. But, the number of cases related to other health endpoints are larger for PM_{10}, which can be attributed to the higher concentration of ambient PM_{10}. It is also observed that the number of cases of chronic bronchitis are overwhelmingly larger than other health endpoints implying that any reduction in $PM_{10}$and $PM_{2.5}$concentration would gain significant benefit from avoiding chronic bronchitisand respiratory diseases in the North Goa district.

ACKNOWLEDGEMENTS

The authors are thankful to the Ministry of Environment and Forest (MoEF). Authors are also grateful to Prof. D.C. Panigrahi, Director, Indian School Mines, Dhanbad for his valuable support during the study. One of the authors is grateful to Indian School of Mines and MHRD/Govt. of India, for granting fellowship.

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Government of Goa
Directorate of Mines & Geology
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Phone Nos. 0832 – 2426431/2425287/2422765

File No. :03/51/2024/Technical/Mines /214 Date : 30/04/2024

To,
The Member Secretary,
Goa State Pollution Control Board,
Near Pilerne Industrial Estate,
Opp. Saligao Seminary,
Saligao, Bardez – Goa.

Sub:- Route Approval.

Sir/Madam,

I am directed to inform you that the following parties applied for Route Approval to this Directorate as mentioned below (copies of application attached):-

Sr. No.	Name of the Applicant	Route applied
1	Ashtek Consultancy Pvt. Ltd.	Colomba/Sulcorna Mine –Revona-Zambavalim-Tilamol-Junction-Ambedkar Circle-Sivaji Circle-Savarde Tisk-Capxem Jetty
2	Providence Realty and Resources LLP	DB Bandodkar Tixem Plot-DB Bandodkar Tixem Jetty
3	Providence Realty and Resources LLP	Sirigao Plant-Bicholim Junction-Karapur Junction-Sankhalim-Navelim-Surla-DBB Tixem Jetty
4	Surakshit Distributors Private Ltd.	Joleracho Dongor-Maina-Caurem-Ambaulim-Quepem-Tilamol-Kakuoddi Xeldem-Curchore-Sanvordem Tisk-Capxem Jetty
5	Vedanta Ltd.	NSP-1 Top-NBP Junction-NBP-Matwada Junction-Sarmanas Jetty
6	Vedanta Ltd.	NSP-1 Top-NBP Junction- Matwada -Sarmanas Jetty
7	Vedanta Ltd.	NSP-1 Top-Dhabdhaba Gate-Matwada Junction-Sarmanas Jetty

In this connection, it is to inform you that the routes at Serial No. 1 to 5 above are considered by this Directorate for transportation of ore. The same applications are forwarded to your office to take necessary action in terms of the Order dated 22/04/2024 passed by the Hon'ble High Court of Bombay at Goa in Misc. Civil Application No. 199 of 2024 in P.I.L Writ Petition No. 6 of 2024 in the matter of The Mulakh Khajan Farmers Association through its Secretary Sakharam Anant Pednekar and Anr V/s The Directorate of Mines and Geology through its Director and 7 Ors.

Yours Faithfully,

(Gaurish Khedekar)
Deputy Director - III

Encl: As Above

Government of Goa
Directorate of Mines & Geology
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File No. :03/51/2024/Technical/Mines | 231 Date : 03/05/2024

To,
The Member Secretary,
Goa State Pollution Control Board,
Near Pilerne Industrial Estate,
Opp. Saligao Seminary,
Saligao, Bardez – Goa.

Sub:- Route Approval.

Sir/Madam,

This is in continuation to this office letter No. 03/51/2024/Technical/Mines/214 dated 30/04/2024.

It is to inform you that the route applied by the party Providence Realty Resources LLP (Route applied - Sirigao Plant-Bicholim Junction-Karapur Junction-Sankhalim-Navelim-Surla-DBB Tixem Jetty), which was indicated at serial no. 3 in the aforesaid letter **is not considered/rejected** by this Directorate.

You may please take a note of the same.

Yours Faithfully,

(Gaurish Khedekar)
Deputy Director - III

Encl: As Above

N (1)

GOA FOUNDATION

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25.04.2024

To,
The Director,
Department of Mines & Geology,
Panaji, Goa.

Subj: Representation/comments of the petitioners regarding mineral transport through village roads, as per HC order dated 22.04.2024.

Dear Sir,

i. In terms of the order dt. 22.04.2024 of the Hon'ble High Court of Bombay at Goa in P.I.L. W.P. 6/2024, we have been permitted to raise our objections/make suggestions in respect of 5 applications for transport of mineral ore through trucks plying along village roads which are pending consideration before the DMG.

ii. Of these, 4 applications are from 3 traders [namely, *Ashtek Consultancy Private Limited; Providence Realty and Resources LLP; Surakshit Distributors Private Limited*] and the last is from Vedanta Ltd. The first 4 are for old ore consignments, and the Vedanta application is in respect of freshly extracted ore.

iii. Please find below our comments/objections/suggestions in connection with the movement of mineral ore through village roads:

A. <u>4 Applications - from 3 traders:</u>

1. The issue of the S.O.P evolved by the DMG for enabling transport of old mineral stocks (*as opposed to fresh extraction under fresh auctions*) on village roads is under consideration of the Hon'ble High Court. The petitioners have raised objections to the S.O.P. document as submitted by the D.M.G. to the High Court. Some issues are raised here as well.

2. This Petitioner, however, states that in the interim, till the S.O.P is considered and approved by the Hon'ble High Court, it has no objection to the transportation of ore as sought for by the 4 applications of the traders if the proposals are also approved by the village community through whose roads the consignments will pass. In contrast to past practice, it must be made mandatory that the village communities are enabled to consider these proposals (*through their gram sabhas*) and grant necessary N.O.C. for the purpose. These village roads do not belong to the DMG, therefore the DMG does not have first right to make use of these roads. Free, prior and informed consent of village communities is a must.

3. One of the principal activities relating to mining which has hit the health of people very hard is the pollution from mineral transportation. In this connection, we refer you to the 2 year study of Goa's mining industry

by the Indian School of Mines, Dhanbad (2011-2013) commissioned by the Ministry of Environment & Forests in 2011. That study titled "Regional Environmental Impact and Management Plan Study of Mining in the Goa Region," has established very clearly that the pollution caused by the mineral transport in the mining belt is one of the most serious problems associated with the industry. I am enclosing a copy of a peer-reviewed paper written by the principal investigator of the Dhanbad study team highlighting some of the issues raised in the study, for your ready reference, since I assume you may not have the time to peruse the entire 2-volume study yourself. Even in the year 2017, P.I.L No. 30/2017 was filed before the High Court requesting it to intervene to halt the sensational dust pollution caused by those working the Sonshi mines taking their trucks through Sonshi village.

Alternatives routes to be examined as well

4. With reference to para 1 of the S.O.P., it needs to be clarified that the D.M.G. will consider the availability of alternate routes, irrespective of whether such route is indicated by the transporter/applicant – as the Department may have more information about alternate routes that exist than the transporter.

5. Subject to the comments in point (2) above, the conditions that were imposed for ore transport by the High Court's order dt. 17.01.2024 in the case of Mayem village, are to be strictly followed in these 4 cases as well, as given below:

Number of trucks per hour needs to be reduced

6. As per paragraph 4 of the S.O.P., the number of trucks permitted to transport ore can range from 20 to 40 trucks per hour, which equates to anywhere between 175 trips per day [@ *20 per hour*] and 350 trips per day [@ *40 per hour*], considering a time period of 8 hrs 45 minutes for ore transport specified in the S.O.P. at para 7.

7. The petitioner submits that the number of trips permissible as per the S.O.P. is grossly excessive. Such a large number of trips per day was part of the problem raised in this petition, when the petitioners approached this Court regarding the ore transport in Maem. Even in this Court's order dt 17.01.2024, the number of trips per day permitted was 50, as these are village roads which host community life and are not designed as roads for intensive, industrial use. In this regard, it is suggested that the maximum number of trips permitted per day ought to be 50 per day. All such materials have been lying in leases and out of leases for several years and there is no urgency that they be transported with speed just because a trader has bought them. In any case, if they wish to transport large quantities urgently, they ought not to transport them through village roads, disturbing the peace and quiet of rural areas. For too long have those involved with ore handling neglected their responsibility of constructing alternative transportation possibilities like covered conveyor belts recommended by ISM Dhanbad, railway sidings as proposed in RP2021 or mining bypasses for this purpose, using resources available to industry bodies like GMOEA and GMA. The mining industry should not be under the

impression that it will be able to use public roads for its private business. That assumption no longer holds.

Timings of transport through villages:

8. The timing for ore transportation as per the S.O.P. is ***8 A.M. – 1 P.M., and 2 P.M. to 5:45 p.m.*** It is submitted that the morning session of ore transport ought to start only from 9 A.M., and continue up till 12:00 P.M.. This way, the peak school rush timings of 8 A.M. and 1 P.M. onwards can be avoided. Students going to attend college and other training courses also walk to bus stops or use their personal vehicles during 8-9 am and 1-2 pm. Road accidents in Goa are many and it is in society's interest that the State curbs unnecessary use of the village roads during these hours.

   Hence, it is suggested that ore transportation ought to be carried out only between ***9 A.M. – 12 P.M., and 2 P.M. to 5:45 p.m.***

Pollution and vehicular controls:

9. The petitioner has made out a separate letter focusing on air pollution and related issues exclusively to the Goa State Pollution Control Board. A copy of the said letter is attached hereto. As such, the points raised therein are not being re-agitated here.

Public disclosure

10. It is important that the public have proper oversight over the movement of ore through villages. We therefore recommend the following:

a) There be CAAQMS (Continuous Ambient Air Quality Monitoring Stations in each of the revenue villages on the transport route, locations to be determined by GSPCB in consultation with the gram sabhas. This data should be available on the websites of the GSPCB and the panchayats.

b) The DMG has a vehicle tracking website. However, this does not show all the active vehicles, or all vehicles carrying minerals on a single map of the state. This functionality was available in 2018 but has been removed without any reason provided.

c) The vehicle tracking website should also provide an overlay of the current air pollution readings from the CAAQMS so that traffic congestion can be correlated with air pollution.

d) Monthly traffic analysis by road segment along with measured pollution levels should be published by the DMG on its website, and sent to the relevant village panchayats for disclosure on their websites.

B. Application of Vedanta Ltd:

11. As per the application made by Vedanta Ltd., a mining block holder, 3 routes are suggested. However, as per new ECs being granted, the route for movement of ores is stipulated in the environment clearance order itself. Hence, except for the route approved in the E.C. order in relation to Mineral Block - I, the DMG has no authority to decide on the acceptance of any route that diverges from the route approved by the M.O.E.F. & C.C. in its E.C. Order.

12. Hence, the request for use of roads other than the one stipulated by the company in the E.C. and on the basis of which the E.C. has been granted, cannot be entertained, as the D.M.G has no power to vary any condition imposed in the EC.

Yours faithfully,

25.04.2024
(Dr Claude Alvares)
Secretary, *for the Goa Foundation*,
Petitioner in P.I.L. W.P. 6/2024

Encl:

1) Letter of the petitioner to the SPCB dated 25.04.2024;

2) Research paper by Gurdeep Singh and Atahar Perwez, "The Spatial Characteristics and Health Impacts of Particulate Matters in the Mining Region of North Goa," 2016.

GOA FOUNDATION

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25.04.2024

To,
The Director,
Department of Mines & Geology,
Panaji, Goa.

Subj: Representation/comments of the petitioners regarding mineral transport through village roads, as per HC order dated 22.04.2024.

Dear Sir,

i. In terms of the order dt. 22.04.2024 of the Hon'ble High Court of Bombay at Goa in P.I.L. W.P. 6/2024, we have been permitted to raise our objections/make suggestions in respect of 5 applications for transport of mineral ore through trucks plying along village roads which are pending consideration before the DMG.

ii. Of these, 4 applications are from 3 traders [namely, *Ashtek Consultancy Private Limited; Providence Realty and Resources LLP; Surakshit Distributors Private Limited*] and the last is from Vedanta Ltd. The first 4 are for old ore consignments, and the Vedanta application is in respect of freshly extracted ore.

iii. Please find below our comments/objections/suggestions in connection with the movement of mineral ore through village roads:

A. <u>4 Applications - from 3 traders:</u>

1. The issue of the S.O.P evolved by the DMG for enabling transport of old mineral stocks (*as opposed to fresh extraction under fresh auctions*) on village roads is under consideration of the Hon'ble High Court. The petitioners have raised objections to the S.O.P. document as submitted by the D.M.G. to the High Court. Some issues are raised here as well.

2. This Petitioner, however, states that in the interim, till the S.O.P is considered and approved by the Hon'ble High Court, it has no objection to the transportation of ore as sought for by the 4 applications of the traders if the proposals are also approved by the village community through whose roads the consignments will pass. In contrast to past practice, it must be made mandatory that the village communities are enabled to consider these proposals (*through their gram sabhas*) and grant necessary N.O.C. for the purpose. These village roads do not belong to the DMG, therefore the DMG does not have first right to make use of these roads. Free, prior and informed consent of village communities is a must.

3. One of the principal activities relating to mining which has hit the health of people very hard is the pollution from mineral transportation. In this connection, we refer you to the 2 year study of Goa's mining industry

by the Indian School of Mines, Dhanbad (2011-2013) commissioned by the Ministry of Environment & Forests in 2011. That study titled "Regional Environmental Impact and Management Plan Study of Mining in the Goa Region," has established very clearly that the pollution caused by the mineral transport in the mining belt is one of the most serious problems associated with the industry. I am enclosing a copy of a peer-reviewed paper written by the principal investigator of the Dhanbad study team highlighting some of the issues raised in the study, for your ready reference, since I assume you may not have the time to peruse the entire 2-volume study yourself. Even in the year 2017, P.I.L No. 30/2017 was filed before the High Court requesting it to intervene to halt the sensational dust pollution caused by those working the Sonshi mines taking their trucks through Sonshi village.

Alternatives routes to be examined as well

4. With reference to para 1 of the S.O.P., it needs to be clarified that the D.M.G. will consider the availability of alternate routes, irrespective of whether such route is indicated by the transporter/applicant – as the Department may have more information about alternate routes that exist than the transporter.

5. Subject to the comments in point (2) above, the conditions that were imposed for ore transport by the High Court's order dt. 17.01.2024 in the case of Mayem village, are to be strictly followed in these 4 cases as well, as given below:

Number of trucks per hour needs to be reduced

6. As per paragraph 4 of the S.O.P., the number of trucks permitted to transport ore can range from 20 to 40 trucks per hour, which equates to anywhere between 175 trips per day [@ *20 per hour*] and 350 trips per day [@ *40 per hour*], considering a time period of 8 hrs 45 minutes for ore transport specified in the S.O.P. at para 7.

7. The petitioner submits that the number of trips permissible as per the S.O.P. is grossly excessive. Such a large number of trips per day was part of the problem raised in this petition, when the petitioners approached this Court regarding the ore transport in Maem. Even in this Court's order dt 17.01.2024, the number of trips per day permitted was 50, as these are village roads which host community life and are not designed as roads for intensive, industrial use. In this regard, it is suggested that the maximum number of trips permitted per day ought to be 50 per day. All such materials have been lying in leases and out of leases for several years and there is no urgency that they be transported with speed just because a trader has bought them. In any case, if they wish to transport large quantities urgently, they ought not to transport them through village roads, disturbing the peace and quiet of rural areas. For too long have those involved with ore handling neglected their responsibility of constructing alternative transportation possibilities like covered conveyor belts recommended by ISM Dhanbad, railway sidings as proposed in RP2021 or mining bypasses for this purpose, using resources available to industry bodies like GMOEA and GMA. The mining industry should not be under the

impression that it will be able to use public roads for its private business. That assumption no longer holds.

Timings of transport through villages:

8. The timing for ore transportation as per the S.O.P. is ***8 A.M. – 1 P.M., and 2 P.M. to 5:45 p.m.*** It is submitted that the morning session of ore transport ought to start only from 9 A.M., and continue up till 12:00 P.M.. This way, the peak school rush timings of 8 A.M. and 1 P.M. onwards can be avoided. Students going to attend college and other training courses also walk to bus stops or use their personal vehicles during 8-9 am and 1-2 pm. Road accidents in Goa are many and it is in society's interest that the State curbs unnecessary use of the village roads during these hours.

   Hence, it is suggested that ore transportation ought to be carried out only between ***9 A.M. – 12 P.M., and 2 P.M. to 5:45 p.m.***

Pollution and vehicular controls:

9. The petitioner has made out a separate letter focusing on air pollution and related issues exclusively to the Goa State Pollution Control Board. A copy of the said letter is attached hereto. As such, the points raised therein are not being re-agitated here.

Public disclosure

10. It is important that the public have proper oversight over the movement of ore through villages. We therefore recommend the following:

a) There be CAAQMS (Continuous Ambient Air Quality Monitoring Stations in each of the revenue villages on the transport route, locations to be determined by GSPCB in consultation with the gram sabhas. This data should be available on the websites of the GSPCB and the panchayats.

b) The DMG has a vehicle tracking website. However, this does not show all the active vehicles, or all vehicles carrying minerals on a single map of the state. This functionality was available in 2018 but has been removed without any reason provided.

c) The vehicle tracking website should also provide an overlay of the current air pollution readings from the CAAQMS so that traffic congestion can be correlated with air pollution.

d) Monthly traffic analysis by road segment along with measured pollution levels should be published by the DMG on its website, and sent to the relevant village panchayats for disclosure on their websites.

B. Application of Vedanta Ltd:

11. As per the application made by Vedanta Ltd., a mining block holder, 3 routes are suggested. However, as per new ECs being granted, the route for movement of ores is stipulated in the environment clearance order itself. Hence, except for the route approved in the E.C. order in relation to Mineral Block - I, the DMG has no authority to decide on the acceptance of any route that diverges from the route approved by the M.O.E.F. & C.C. in its E.C. Order.

12. Hence, the request for use of roads other than the one stipulated by the company in the E.C. and on the basis of which the E.C. has been granted, cannot be entertained, as the D.M.G has no power to vary any condition imposed in the EC.

Yours faithfully,

25.04.2024
(Dr Claude Alvares)
Secretary, *for the Goa Foundation*,
Petitioner in P.I.L. W.P. 6/2024

Encl:

1) Letter of the petitioner to the SPCB dated 25.04.2024;

2) Research paper by Gurdeep Singh and Atahar Perwez, "The Spatial Characteristics and Health Impacts of Particulate Matters in the Mining Region of North Goa," 2016.

Ericsson, IIT Kanpur & Airtel collaborate with Rajasthan Pollution Control Board to monitor air quality in Jaipur

Ericsson (NASDAQ : ERIC) , Indian Institute of Technology Kanpur (IIT Kanpur) and Bharti Airtel ("Airtel"), India's premier communications solutions provider, have collaborated with the Rajasthan Pollution Control Board (RSPCB) to deploy Narrow Band - IoT sensors in Jaipur city to monitor air pollution in real time and raise public awareness.

PRESS RELEASE | MAR 14, 2022

The low-cost Narrow Band-IoT based air quality sensors have been installed at 40 key locations in Jaipur. These sensors are compact, simple to install, and require minimal maintenance. The real-time data collected by the sensors is analyzed by RSPCB and displayed to the public at five identified locations in the city - Yadgar Jaipur; Near VKIA Police Station Jaipur; Govt. Secretariate Jaipur; Airport Sanganer Jaipur; and RSPCB Head Office Jhalana-Dungri Jaipur. These displayed data will include PM2.5, PM10, and air quality index (AQI) concentrations.

In addition to increased public awareness, this will support policy intervention, and enable corrective actions to be taken to reduce air pollution.

As part of the collaboration, IIT Kanpur is also launching a mobile app for easy access to the air quality data. This will not only help in understanding the generated data on PM and AQI in a more meaningful way but also aid in raising public awareness about air pollution levels among Jaipur residents.

Ms Veenu Gupta, Chairperson, Rajasthan State Pollution Control Board states, "I am very happy to launch this project and appreciate the efforts made by IIT Kanpur, Ericsson and Airtel in developing and supporting this low cost sensor network project in Jaipur. It will help in

better understanding of the air quality of Jaipur and formulating a scientific action plan for control of air pollution in city".

Prof. Sachchida Nand Tripathi, Department of Civil Engineering, IIT Kanpur said "The collaboration with Ericsson mainly by implementing NB IoT has helped sensors data transmissibility, reduced power consumption and increased battery life. This has resulted in more autonomous sensor network."

Sonia Aplin, Head of Marketing & Communications, SCR and GIR, Ericsson South east Asia , Oceania and India states, "Having successfully deployed our NB-IoT sensor based solution for measuring air quality in Delhi, we are happy to scale and deploy this solution in Jaipur city. This project will enable Jaipur city to better manage the pollution levels by creating awareness amongst residents and authorities, leading to better air pollution management. At Ericsson, we are committed to working with partners across and beyond the ICT ecosystem to improve lives and build a sustainable future."

Mr. Sundereshwaran Raman, Head of Digital Products, Airtel Business shared "Our mission is to leverage Airtel's IoT capabilities for serving our customers and also for the larger good of the society. Pollution and climate change are critical agendas for all of us and we, at Airtel, are delighted to join forces with Ericsson, IIT-Kanpur and RSPCB to help improve air quality in the city."

The partnership will also include working with community-based organizations to raise awareness regarding air pollution and steps that can be taken to reduce it. To date, 10 institutions, schools, and community groups have been paired with the initiative and 85 students have been trained as air quality champions to participate in monitoring and developing actions to reduce air pollution.

NOTES TO EDITORS:

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ABOUT ERICSSON:
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(1999) 3 Supreme Court Cases 141

a (BEFORE S.P. BHARUCHA, S.S.M. QUADRI AND R.C. LAHOTI, JJ.)

SARASWATI INDUSTRIAL SYNDICATE LTD. .. Appellant;

Versus

COMMISSIONER OF INCOME TAX HARYANA, ROHTAK .. Respondent.

b Civil Appeals Nos. 1804-06 of 1981† with Nos. 4975-78 of 1993 and 5671 of 1985‡, decided on March 10, 1999

A. Income Tax — Depreciation — AYs 1970-71 to 1977-78 — Higher rates of depreciation under Item III(ii)B(7) of para III of Pt. I of Appendix I to IT Rules, 1962 on machinery and plants — Conditions for applicability of — Coming into contact of the machinery with a pure corrosive chemical, held, not necessary — It is enough if the substance passing through the machinery c contains chemicals which are corrosive and have the effect of wearing down the machinery — Income Tax Rules, 1962, Appendix I Pt. I para III Item III(ii)B(7)

B. Income Tax — Reference — Technical matters — Proper course for deciding — Sugar-manufacturing machinery using cane juice treated with corrosive chemicals whether for that reason could be said to be coming into contact with corrosive chemicals within the meaning of Item III(ii)B(7) of para III of Part I of Appendix I to IT Rules, 1962 — In absence of any basis having d been laid down on the record by either party for that purpose, held, High Court should not have made any statement on such a technical matter and should not have decided the question relying on such statements — Hence, Supreme Court directing the ITAT to decide the question after taking further evidence and, thereafter, to refer to the High Court a supplemental statement of the case — Income Tax — Depreciation — Rates of — Income Tax Rules, 1962, App. I Pt. I para III Item III(ii)B(7) — Income Tax Act, 1961, S. 256 — Practice and e Procedure — Technical matters — How to be determined

C. Income Tax — Depreciation — AYs 1970-71 to 1977-78 — Provision in Item III(ii)B(7) of para III of Pt. I of Appendix I to IT Rules, 1962 for higher rate of depreciation on machinery and plant coming into contact with corrosive chemicals — Object of — Explained

D. Practice and Procedure — Intervener — Rights of — Held, he is entitled f to address arguments in support of either side but is not himself entitled to relief in the intervention application — Constitution of India, Art. 136 — Relief — Intervener, held, not entitled to, in intervention application

In view of Item III(*ii*)B(7) of para III of Part I of Appendix I to the Income Tax Rules, 1962, the assessee claimed depreciation at the higher rate of 15% on the machinery it used in manufacture of sugar. In support of the claim, the assessee filed the opinion of an expert, which the ITO refused to consider on account of non- g production of the expert by the assessee for cross-examination. Moreover, the ITO rejected the assessee's claim. In reference, the High Court made certain observations on the nature of the sugarcane juice and held the same to be not a corrosive chemical. Allowing the assessee's appeal, the Supreme Court

† From the Judgment and Order dated 21-4-1981 of the Punjab and Haryana High Court in h I.T.Rs. Nos. 130, 98 and 100 of 1976

‡ From the Judgment and Order dated 17-11-1988, 19-9-1989 and 4-3-1985 of the Punjab and Haryana High Court in ITRs Nos. 157, 114 of 1979, 23-24 of 1984 and 96 of 1984

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Held :

One can understand that the authorities declined to rely upon the expert's opinion because he was not produced for cross-examination. But neither the ITO nor the High Court were entitled to make statements on technical matters for which no basis had been laid on the record by either the Revenue or the assessee. If the High Court was of the view that further material was required, the appropriate course was to require the ITAT to take further evidence and draw up a supplemental statement of case. (Para 6)

Moreover, there appears to be some misunderstanding of what Entry III(*ii*)B(7) is intended to convey. Depreciation at a higher rate is allowed to machinery that comes into contact with corrosive chemicals. Corrosive chemicals corrode the machinery. They erode and by reason of such erosion, the life of the machinery is truncated. To compensate, depreciation is allowed at a higher rate. It is not intended that the machinery must come into contact with a pure corrosive chemical. It is enough that what passes through the machinery contains chemicals which are corrosive and which, therefore, have the effect of wearing it down. (Para 7)

The interveners' request to be given the same order as has been passed herein cannot be granted in intervention application. The only purpose of granting an intervention application is to entitle the intervener to address arguments in support of one or the other side. (Para 12)

[**Ed.:** The Supreme Court remanded the matter to the ITAT to take further evidence and then to decide whether the assessee's machinery was eligible for the higher rate of depreciation. The Supreme Court further directed the ITAT to draw up a supplemental statement of case and directed the High Court to rehear the matter. (Para 8)]

H-M/T/20900/C

Suggested Case Finder Search Text (*inter alia*) :

"income tax" depreciation machin*

Advocates who appeared in this case :

G.C. Sharma, Senior Advocate (R.K. Ragavan, S. Chaudhary, B.V. Desai and S.K. Agarwal, Advocates, with him) for the Appellant;

Ranbir Chandra, Rajiv Nanda, C.V.S. Rao, B.K. Prasad and S.K. Gambhir, Advocates, for the Respondent.

The Judgment of the Court was delivered by

BHARUCHA, J.— Under appeal are the judgments and orders of Division Benches of the Punjab and Haryana High Court. The assessment years involved are Assessment Years 1970-71 to 1977-78. The High Court answered in the negative and in favour of the Revenue the following question:

> "Whether on the facts and in the circumstances of the case, the Tribunal was right in law in holding that the words 'corrosive chemicals' employed in Item (*ii*)B(7) of para III of Part I of Appendix I to the Income Tax Rules, 1962 contemplates not only free chemicals but also non-free chemicals of corrosive effect."

The assessee is in appeal.

2. The assessee manufactures, among other things, sugar. It claimed depreciation at the higher rate of 15% on machinery it used in the

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manufacture of sugar, which was detailed in a statement placed before the Income Tax Officer. It did so having regard to Item III(*ii*)B(7) of para III of Part I of Appendix I to the Income Tax Rules, 1962, which reads thus:

> "III. (*ii*)B(7) Machinery and plant coming into contact with corrosive chemicals. rate of depreciation 15%"

3. The assessee filed in support of its case the opinion of an expert. The Income Tax Officer rejected the assessee's claim of higher depreciation at the rate of 15% on such machinery. He declined to consider the expert opinion on the ground that the assessee was unable to produce the expert for cross-examination. He referred to the meaning of the word "chemical" and concluded that cane juice was not something which was obtained through a chemical process nor was it used for chemical effect. The contention of the assessee that during the manufacture of sugar, the juice was treated with corrosive chemicals like sulphuric and phosphoric acid which had corrosive effect on the sugar machinery could not be given any importance as the quantity used was quite small and it was not those acids which came into contact with the machinery. They formed a very small part and their use was confined to a particular stage. It was the cane juice which was the main substance that came into contact with the machinery. The Appellate Assistant Commissioner dismissed the assessee's appeal. His view was that depreciation was allowable at the higher rate on such plant and machinery in which chemicals with high corrosive potentials were used for manufacturing purposes and the manufacture of sugar did not fall in such category.

4. The Income Tax Appellate Tribunal disagreed. It noted that the only criticism directed against the statement which had been tendered by the assessee before the Income Tax Officer was that it included machinery that came in contact not with corrosive chemicals but with cane juice and molasses which were not corrosive chemicals but, at best, corrosive materials. The Tribunal found no force in this criticism for the reason that the corrosive chemicals contemplated in the said entry were not only free chemicals but also non-free chemicals provided they were corrosive in effect so far as metals are concerned.

5. Out of the order of the Tribunal, the question quoted above was referred to the High Court. The High Court disagreed with the Tribunal for the reason that according to it, lime and sulphuric acid were mixed with the sugarcane juice to filter and purify the juice but by their mixture, the juice itself was not converted into a chemical. Reference was made to the dictionary meaning of the word "chemical" and it was said that it was obvious therefrom that sugarcane juice could not be covered by the term simply because some acid has been mixed with it for its filtration. The acid and the lime were mixed in the sugarcane juice for the purpose of its filtration and once the chemical reaction had been caused, most of its effect was lost. Whatever remained settled down along with the sediments at the bottom. Thereafter, the filtered sugarcane juice which came into contact with

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the machinery before it was converted into crystallised sugar could not be said to be a corrosive chemical.

6. We can understand that the authorities declined to rely upon the expert's opinion because he was not produced for cross-examination. But neither the Income Tax Officer nor indeed the High Court were entitled to make statements on technical matters for which no basis had been laid on the record by either the Revenue or the assessee. If the High Court was of the view that further material was required, the appropriate course was to require the Tribunal to take further evidence and draw up a supplemental statement of case.

7. This apart, there appears to be some misunderstanding of what the said entry is intended to convey. Depreciation at a higher rate is allowed to machinery that comes into contact with corrosive chemicals. Corrosive chemicals corrode the machinery. They erode and by reason of such erosion, the life of the machinery is truncated. To compensate, depreciation is allowed at a higher rate. It is not intended that the machinery must come into contact with a pure corrosive chemical. It is enough that what passes through the machinery contains chemicals which are corrosive and which, therefore, have the effect of wearing it down.

8. In the instant case, with this understanding of the said entry in mind, the Tribunal shall take further evidence, giving both the assessee and the Revenue the opportunity of producing it and based thereon, shall decide whether the machinery for which the assessee claims depreciation at the higher rate is entitled to it. It shall then draw up a supplemental statement of case and the matter shall be reheard by the High Court, having regard to what is found by the Tribunal and to this judgment.

9. The appeals are allowed. The judgments and orders under appeal are set aside. The matters are remanded to the Tribunal to be proceeded with as set out hereinabove.

10. This order shall also govern Appeal No. 5671 of 1985 where reference to the question of law aforementioned was declined. Even in this matter, the Tribunal shall conduct a further enquiry as indicated above and draw up a supplemental statement of case and it shall then refer the question aforementioned to the High Court.

11. No order as to costs.

12. Learned counsel for the interveners submits that he is entitled to the same order as we have just passed. We cannot pass such an order in an intervention application. The only purpose of granting an intervention application is to entitle the intervener to address arguments in support of one or the other side. Having heard the arguments, we have decided in the assessee's favour. The interveners may take advantage of that order.

13. Order on the intervention application accordingly.

Government of India
Ministry of Environment, Forest and Climate Change
IA Division
(Non-Coal Mining)
***

सत्यमेव जयते

Minutes of AGENDA FOR 24TH EAC MEETING OF THE EXPERT APPRAISAL COMMITTEE (NON-COAL MINING SECTOR), SCHEDULED TO BE HELD DURING 26-28 DECEMBER, 2023 THROUGH VIDEO CONFERENCE. meeting Non-Coal Mining held from 26/12/2023 to 28/12/2023 **Date: 05/01/2024**

MoM ID: EC/MOM/EAC/904227/12/2023

Agenda ID: EC/AGENDA/EAC/904227/12/2023

Meeting Venue: N/A

Meeting Mode: Virtual

Date & Time:

26/12/2023	10:30 AM	05:30 PM
27/12/2023	10:30 AM	05:30 PM
28/12/2023	10:30 AM	05:30 PM

1. Opening remarks

The 24th meeting of the Re-Constituted Expert Appraisal Committee (EAC) for Environmental Appraisal of Mining Projects (Non-Coal) of the Ministry of Environment, Forest and Climate Change was held during 26-28 December, 2023 through video conference. The list of participants is annexed herewith. After login of the Committee Members through video conference link provided by NIC discussion on each of the Agenda Items was taken up ad-seriatim.

2. Confirmation of the minutes of previous meeting

The minutes of the 23rd EAC meeting held during 5-7 December, 2023 were placed before the members of the EAC.

3. Details of proposals considered by the committee

Day 1 -26/12/2023

3.1. Agenda Item No 1:

3.1.1. Details of the proposal

Guruvanipalli Limestone Mine (M.l Area 395.15 Ha) with expansion In limestone Production Limestone from 0.30 Million TPA To 4.00 Million TPA, Soil: 0.31 Million TPA (Total Excavation: 4.31 Million TPA) at Village Guruvanipalli (Revenue Village: Petnikota), Taluka- Kolimigundla, District- Kurnool (Andhra Pradesh) By M/s. Ultratech Cement Limited. by M/s. UltraTech Cement Ltd. located at **KURNOOL,ANDHRA PRADESH**

. Agenda Item No 5:

5.1. Details of the proposal

Block 1- Bicholim Mineral Block for Iron Ore by VEDANTA LIMITED located at NORTH GOA,GOA			
Proposal For		Fresh EC	
Proposal No	File No	Submission Date	Activity (Schedule Item)
IA/GA/MIN/442593/2023	IA-J-11015/3/2023-IA-II(NCM)	01/09/2023	Mining of minerals (1(a))

3.5.2. Project Salient Features

The instant proposal is for mining of Iron Ore in Bicholim Mineral Block – Block 1 (Auction Block) of M/s Vedanta Limited with proposed production capacity of 3.0 MTPA, Waste: 25.162 MTPA (Total Excavation: 28.162 MTPA) along with crushing and screening plant capacity of 4.0 MTPA in the mine lease area of 478.5206 ha, located at Bicholim, Bordem, Lamgao, Mulgoa, Mayem&Sirigao Villages of Bicholim Taluka of North Goa District, Goa.

2. The details of the project as ascertained from the document submitted by the Project Proponent and revealed from the discussions held during the meeting are given as under: -

i. The proposed project activity is listed at schedule no. 1(a) Mining of Minerals and falls under Category "A" as the mining lease area is greater than 250ha and appraised at the Central level.

ii. The mine lease area is located between Latitude: 15°34'20.518"N to 15° 36'54.018"Nand Longitude: 73°54'4.754"E to 73°57'09.51"E. The mine lease area falls under the Survey of India Toposheet No: D43B14 and falls in Seismic Zone-II.

iii. The proposal was earlier considered in the 20thEAC (Non Coal Mining) meeting held during 21-22 September, 2023 wherein the EAC deferred the proposal for want of requisite information and site visit report of the subcommittee. Accordingly, site visit was carried out during 29-31 October, 2023 and then the Project Proponent submitted the information along with compliance of site visit report on 04.12.2023 in Parivesh portal and hence the proposal was considered in the 24th EAC (Non-Coal Mining) meeting held during 26-28 December, 2023.

Based on observation of EAC in its meeting held during 21-22 September, 2023 and observations of sub-committee during site visit (29-31 October, 2023), the project proponent provided the following compliances:-

S. No	Observation of subcommittee during site visit held during 29-31 October, 2023	Reply by Project Proponent
1	The Project Proponent needs to submit the techno economic feasibility report for laying Over Land Belt Conveyor (OLBC) from	The Project Proponent submitted that transportation route from mine site to jetty currently covers a total distance of 5.48 kms (4.54 dedicated road and 0.94 km MDR-20 Public Road). Based on the present capacity of the tippers, 1205 trips are required per day and the present road network is adequate for the purpose with widening and strengthening of some patches. The preliminary Techno-Economic feasibility study has been undertaken and prima facie it does not look feasible to switchover to OLBC system considering the terrain of the likely route having mounds and low-lying areas, vegetation/forest patches and its likely degradation, accessibility, environmental impacts and safety issues, technologies available, cost of the system, implementation period via-a-vis remaining reserves in the mining lease. The Project Proponent also submitted the preliminary Techno-Economic feasibility issues for

	the mine lease area to Sarmanas Jetty.	laying Over Land Belt Conveyor (OLBC) from the mine lease area to the Sarmanas Jetty along with cost and timeline comparison for conveyor system and dedicated road.
2	The subcommittee asked the Project Proponent to submit the ecology restoration plan for mined out pits for using as Water reservoir Pisciculture.	The Project Proponent submitted that the Ecology Restoration or Mine Reclamation activities at Block I Bicholim Mineral block will be carried out concurrently with mining operations. The company has in-house experienced team having experience of mine land reclamation. The company also proposes to collaborate and take support of various reputed institutes and consultancy firms in ecology restoration of the area more importantly the local stake holders will be consulted in the process of ecology restoration. The Project Proponent also submitted that at conceptual stage, 20 ha area will be converted into water reservoir & 293.5 ha will be converted into backfilled area. Backfilled area will be reclaimed & rehabilitated by the plantation. At conceptual stage around 105 ha (21.94% of the total project area) of land will be brought under plantation.The plantation will comprise of saplings of native species which are generally grown in the state of Goa.The plantation would be a mix of various forest and fruit tree species and technical advice would be taken from state forest and agriculture departments. The saplings will be procured from various nurseries like forest department nursery, nurseries developed by locals and also from companies in-house root trainer nursery. Further, the Project Proponent submitted that the Block-I Bicholim Mineral Block is already having a 7.5m wide green belt all along the mine block boundary except the areas where the mine block shares a common boundary with adjoining mine block. A 50m green belt exists towards the habitation within the lease and the same would be further strengthened and maintained. A dedicated 200m green belt would be developed and maintained towards the Idgah area. A density of 2500 saplings per ha will be maintained. Extensive plantation would also be done along the sides of connecting roads. The waste dump slopes will be covered with laterite material and then with biodegradable geotextile mats which will prevent soil erosion of the dump slopes and thus will facilitate the growth of native species. Grass seeds will be sprinkled on the dump slopes so that the same germinate during rains. The top of dump areas / levelled areas will be properly planned and developed in to theme based gardens which can be a attraction for school students, tourist etc. Some of the mined-out pits will partially backfilled and retained as water bodies.For instance, 1 Top pit and 5 Bottom pits will be finalized by end of first mine plan period and will be taken up for ecology restoration initiatives. The company will collaborate with state fisheries department to develop Pisciculture in the water body developed in the mine pits. Local youth will be provided training through the fisheries department so that they manage and maintain the Pisciculture project.
3	The subcommittee noted that the transfer of material from one pit to other working pit will lead to transportation issues. The subcommittee asked the Project Proponent to i	The Project Proponent submitted that as suggested by the Hon'ble Committee detailed study of mineral transportation from one pit to another pit including sequential mining has been carried out. The company has explored the possibility of concurrent backfilling and it will be possible only from 5thto 10thyear. The Project Proponent submitted the google image showing the existing available pits for backfilling and proposed pits for backfilling. The Project Proponent also submitted the details of existing pits, area, depth and volume for backfilling and also the proposed working pits, area, depth and volume available for backfilling. Further, the Project Proponent submitted the year wise sequential mining & backfilling plan.

	dentify the shortest le ad distance and also to explore the possibility of concurr ent backfil ling. The P roject Prop onent also needs to su bmit the se quential st age wise m ining in to p and botto m working pits and th eir backfill ing plan.	
4	The Projec t Proponen t needs to s ubmit the a ction plan for strengt hen the set tling pond with prope r stone pitc hing in lin e with the design of s ettling pon d consideri ng the ann ual rainfal l, flow rat e, catchme nt area and its dischar ge. The act ion plan fo r monitori ng the wat er level an d water qu ality befor e discharg e needs to be submitt ed.	The Project Proponent submitted that at conceptual stage, total 12 no.s of settling ponds will be developed and these will be strengthened by the stone pitching. About 6 numbers of earlie r mined out abandoned pits and 12 nos of interlinked siltation ponds have been identified for collecting surface run off from respective catchment sub basins. The Project Proponent also s ubmitted the map showing the settling ponds and drainage network and design of settling pon ds. The Project Proponent submitted that a total of 5.49 Million CuM of void volume is available for surface run-offf holding in six pits having a cumulative area of 58.11 Ha which have a tot al catchment area of 160 Ha. During entire mine life water holding capacity of 5.49 or more t han 5.49 Million CuM will be available at any time. Further, a total 12 nos of settling ponds have been earmarked within and outside the ML Area for collecting surface run off. A total o f 0.38 Million M3 of void volume is available for surface run-offf holding in 12 nos settling ponds having a cumulative area of 8.84 Ha. Considering five fillings in a year, the gross volu mes of settling ponds will be 1.90 Million M3. Further, the Project Proponent submitted that entire monsoon runoff is channelized into mine pits and supernatant water flows into series of settling ponds through drains. The clear water is allowed to naturally overflow by Header arrangements or through check dams.In case requ ired, Lime or combination of Lime and flocculent is used in the mine pit or settling pond so t hat the particles settle, and clear water is discharged. The discharge water is monitored regula rly so that water quality meets the prescribed limits. The inhouse Environment management c ell will undertake the regular monitoring and analysis of discharge water through Environme nt laboratory recognized by MoEF&CC. The monitoring reports will be submitted to Goa Sta te Pollution Control Board on monthly basis and MoEF&CC Regional office on six monthly basis. Surface water samples shall be collected at 8 locations which include all the mine discharge points and upstream and downstream of Bicholim and Asnora river. Samples shall be collect ed once a month. The parameters listed in IS: 2296 shall be monitored. During monsoon seas on, in addition to the monthly monitoring, all the discharge points will be regularly monitore d (on all the rainy days) and the TSS levels will be checked.
5	The design of garland drain arou nd the was	The Project Proponent submitted that the dimensions of the drains will be maintained with wi dth of 2m and 1.5 m in depth everywhere in the mine. A proper height will be maintained on the sides of the garland drain so that water does not get overflooded from the drains. The avai lable garland drains are 11313 m in length which covers all the dumps within the mine lease

	te dumps to divert the water to settling ponds and the measures to be taken to arrest the suspended solids needs to be submitted. The measures to be taken for preventing the soil erosion on slope of waste dumps needs to be submitted.	area. The same will be strengthened and maintained before the onset of monsoon. The daily average surface run-off is estimated as 14003 m3. The garland drains have the capacity to accommodate instant volume of 33939 m3 as per above dimensions. Therefore, garland drains capacity is more than sufficient to take care of average daily surface run off during raining period. Additional drains are proposed to take care of peak run off during the plan period. Therefore, water management structures comprising of drains, settling ponds and mined out pits are available as well as planned to address the catchment area run-off for conceptual period. The Project Proponent also submitted the measures to be taken to arrest the suspended solids and for preventing the soil erosion on slopes of waste dumps for preventing the soil erosion on slope of waste dumps which are as follows: 1. Inward slope will be provided to all the dump benches so that the water doesn't flow over the slope and erodes the dump slope surface 2. Covering the finalised dump slope with lateritic material and then covering with coir geotextiles 3. Use of ERW pipes between benches to channelise the surface runoff water and diverting to settling ponds. 4. Boulder walls 1.5m ht and 2m wide will be provided at the toe of the dump to arrest the flow of silt. 5. Garland drains around the dump is constructed 1m bottom width, 2m top width and 1m deep with a length of 6100 m to divert water to settling pond for arresting the suspended solids. 6. Use of Styllo grass seeds and Glyricidia cuttings at the onset of monsoon to create green cover on the dump slopes. 7. Annual Plantation of native species on waste dump. 8. Safety green belt /barrier of 50 mts shall be maintained near the Assonora river from the mine pit. 9. Annual de-siltation of the settling ponds, drains. 10. Use of lime and flocculants in case required so as to settle the suspended solids in settling pond.
6	The Project Proponent needs to submit the action plan for installing permanent water sprinklers.	The Project Proponent submitted that permanent water sprinklers with 3.40 km length along the haul road within the ML area and 2.80 km length outside the ML area on either side of the road will be installed. Sprinklers will be spaced at 12m distance covering 6m radius at 180 degree. Estimated budget for the installation of the same is Rs. 191.60 Lakhs. S. No | Description | Cost (Rs. In Lakh) 1 | Civil Works | 20.0 2 | Pump & Sprinkler System | 88.0 3 | Pipeline | 75.60 4 | Electrical Works | 8.0 | Total | 191.60 The Project Proponent also submitted the map showing the layout of proposed water sprinklers within mine lease area and along dedicated road.
7	The Project Proponen	The Project Proponent submitted that Crushing &screening units will be modified within 4 months after obtaining the Clearances. Budget proposed for the same is Rs. 6.97 Crore.The Pro

	t needs to submit the action plan and timeline to modify the crushing and screening units. The Project Proponent also needs to submit the material flow sheet and material balance.	ject Proponent alsosubmitted the flow Sheet of Crushing & Screening Unit.
8	The Project Proponent needs to submit the action plan for developing their own nursery by mentioning the details of the area to be covered, species to be planted and budget proposed. Most of the standing vegetation in the lease area constitutes of Acacia auriculiformis and Casuarina equisetifolia and it is further invading the open areas through natural regeneration. The invasion may be checked through planting native species in the region.	The Project Proponent submitted that it is proposed to develop nursery adjacent to the mineral block (Survey no 72/4 in Bicholim Village). Around 1100 sq.m of area will be utilized for the nursery. A budget of Rs. 5 lakh is kept for the same.The nursery will comprise of following: 1. A poly house/ nursery shed will be developed where in a root trainer nursery will be established. 2. Production area wherein various jobs like filling of root trainers/polybags will be undertaken store room wherein the nursery equipment's will be stored 3. Only native / local species of various horticultural and forest species will be grown in inhouse nursery or sourced from forest department nursery for planting in the finalised areas within the Mineral block. 4. Necessary technical support will be taken from state forest department. Company also carries out collaborative mine reclamation projects in association with research institutes like NEERI, Goa university etc. 5. Horticultural species like Mango, Cashew, Ber, Aonla, Jambul, Tamarind, Jackfruit, citrus species, etc will be grown 6. Forest species like various Terminalia tomentosa, Terminalia bellerica, Bauhinia species, Teak, Cassia fistula, Arjun, Assan, lagerstromia species, Shiwan, Ficus species, Pongamiapinnata, Reetha, Rain tree, Pangara, Peltoforum, Palas, Saton, Mahagony, bamboo species etc. The Project Proponent also submitted that during plan period an area of 9.7288 ha (24,322 no. of plants) will be developed under 7.5m safety zone, Buffer towards habitation, archaeological site, & river and an area of 9.4435 ha (23,609 no. of plants) will be developed on backfilled area. A budget of Rs 28.83 Lakhs has been earmarked towards the same.

9	The Project Proponent needs to ensure that whether any other Schedule-I species has been added as per latest Wildlife (Protection) Amendment Act 2022 or not. Accordingly, the Project Proponent shall submit the revised authenticated Schedule-I species.The Project Proponent also needs to submit the breakup of the conservation activities proposed under Wildlife Conservation Plan.	The Project Proponent submitted that the authenticated list of Schedule I Species as per Indian Wildlife Protection Act 1972 as amended Gazette Notification of Wildlife (Protection) Amendment Act, 2022 has been obtained from the Dy. Conservator of Forests Wildlife & Eco-Tourism (North), Panji-Goa vide letter no. 1-576-WL&ET(N)/2023-2024/3312, dated 27.11.2023. According to this authenticated list, 29 Schedule I Species have been recorded within 10 km study area. As suggested by the Hon'ble EAC the company revised the break-up of conservation activities proposed under Wildlife Conservation Plan and same will be finalized after discussion with the Forest Dept. The break-up of the conservation activities proposed under Wildlife Conservation Plan are as follows:-

S. No	Particulars	1st year	2nd year	3rd year	4th year	5th year
1	Enrichment of forest areas with suitable indigenous species for wild life habitat improvement	12	12	12	12	12
2	Creation/ maintenance of habitat for herbivores/ avian fauna					
3	Management interventions for facilitating water availability to the wild life in forest areas/ Improvement of soil and water regime of forest areas					
4	Financial support to the department for conducting awareness campaigns for various stakeholders					
5	Financial support to the department for celebrating events like Wildlife week and sponsoring the prizes for the competitions					
	Total	Rs 60.0 Lakhs				

10	The Project Proponent needs to submit the map demarcating the surface features in the mine lease area and their safety d	The Project Proponent submitted the map demarcating the surface features in the mine lease area. The Project Proponent also submitted the safety distances left/maintained as per mines acts and rules as given below in table:

S. No	Features inside lease	Distance from Ultimate Pit Limit (UPL)	Statutory Distances as per MMR
1	ManasbagMulgao vill	120 m	

istances left/maintained as per mines acts and rules.

	age		45 m
2	Mulgao village	58 m	
3	Lamgao village	56 m	
4	Manaswada Govt. School within habitation	138 m (12 Students)	45 m
5	Gaonkarwada Govt. School within habitation	190 m (not functional)	
6	Old Lairai Temple	126m (From 5 Bottom Backfilling site)	45 m
7	Mahadev&Sateri Temple	280 m	
8	Kelbai Temple	205 m	
9	Sateri Temple	130 m	
10	Matrai Temple	150 m	
11	Nimuzgah	210 m	
12	Lamgao Caves	300 m	45 m

11	The Project Proponent needs to provide proper treatment of channels and nallas flowing in the lease area for soil and water conservation. Scientifically designed and placed check dams and other engineering structure	The Project Proponent submitted that Silt load study was carried out through Center for Advance studies department of geology, University of Delhi and it was concluded that, all the structures made for the settling of sediments are found to be more than sufficient to accommodate sediments even during peak rainfall. The Project Proponent submitted that the 1. Total length of the Garland drain = 11313 m 2. Peak rainfall = 154 mm/day 3. Peak runoff in a day = 110590 m3 4. Capacity of garland drain = 33939 m3. The garland drains are made such that from upstream to the downstream where the drains are meeting the settling ponds will show decrease in elevation, to maintain a free-flowing gradient of rainfall runoff. The dimension of the drains is maintained to be 2m in width and 1.5m in depth at everywhere in the mine site. A proper height has been maintained on the sides of the garland drain so that water don't' get over-flooded from the drain.

	s at differe nt places c an help co ntrol the er osion and l oss of prod uctive soil. Necessary study from competent institution/ individuals may be do ne for this purpose.	
S. N o	Observatio n of EAC i n its meeti ng held du ring 21-22 Septembe r, 2023	Reply by Project Proponent
1	The site vi sit report o f the subco mmittee.	The Project Proponent submitted the observations to the subcommittee recommendations dur ing the site visit 29-31Oct., 2023 are complied and submitted in Parivesh portal.
2	The Projec t Proponen t needs to r evisit the p lan for bac kfilling wit h clearly in dicating th e voids are a and the c apacity av ailable/req uired for b ackfilling.	The Project Proponent submitted that 5 numbers of earlier mined out pits have been identific d for backfilling purpose to accommodate waste to be generated in future besides additional pits to be made available progressively with mining till conceptual period. The physical detai ls of available pits to be converted into backfilled areas are as follows:

Mine pi t locati on/ ID	Total a rea of p it (ha)	Area Availa ble for Back filling (Ha)	Dept h (m)	Top RL (m)	Bot RL (m)	Vol (m 3)
1 Top	22.436 7	20.9942	99	62	-37	193 561 83
2 Top	13.080 3	9.9465	60	60	0	296 892 0
3 Top	16.059 6	13.1650	70	110	40	224 000 0
¼ Botto m	-	-	109	102	-7	-
5 Top	37.024	35.7242	78	98	50	142

	2					131 24
5 Top CB	-	-	77	124	47	-
5 Botto m	15.419 6	12.0840	92	87	-5	703 524 0
Total	104.02 04	91.9139				458 134 67

Further, the details of pits to be made available progressively with mining till conceptual peri od and converted into backfilled areas are as follows:

Mine pit lo catio n/ ID	Total area of pit (ha)	Area A vailable for Bac kfilling (Ha)	Dep th (m)	Top RL (m)	Bot RL (m)	Vol (m 3)	Void a vailabil ity for backfil ling
2 Top	43.1 944	39.2331	116	91	-25	105 189 96	5th yea r
¾ Bot tom	39.4 606	34.6140	169	102	-67	154 126 43	End of 3rd yea r
2 Top	68.5 2	65.6420	113	103	-10	479 120 00	6th to 10th ye ar
3 To p/2 T op co mbine d	38.2 545	36.6500	118	108	-10	381 612 00	11th to 13th ye ar
4 To p/3 T op Co mbine d	-	-	84	73	-11	-	11th to 13th ye ar
5 Top CB Pi t	-	-	168	94	-74	-	11th to 13th ye ar

Total	189.425	176.1391				112004839	

As shown in the above tables, five numbers of earlier worked out pits will have void volume of 45.81 million m3 and during the Plan & Conceptual period progressive excavation, 112 million m3 of void volume will be available for backfilling. Therefore, a total of 157.98 million M3 of void volume will be available for backfilling in mined out pits having a cumulative area of 268.05 Ha. Additionally, area of 62 Ha will be available as voids including 22 ha of water reservoir for storing rain water.

The Project Proponent also submitted that the Conceptual waste generation shall be 124.9 million Cum which will have a swelled volume of 149.90 million CuM (say 150 million CuM). The 0.2 million CuM of swelled waste will be dumped over top of backfilled pits as surface dumps. Sufficient space is available to accommodate waste generated during life of mine considering swell factor of 1.2.Annual waste generation is in range of 4.35 to 12.58 million cum per year with an average of 9.61 million cum per year considering life of the mine as 13 years based on the presently available mineable reserves. Life of the mine may reach upto 30 years if entire resources are converted to reserves by removing all encumbrances.

3	The Project Proponent needs to submit the design of settling ponds by considering the annual rain fall, catchment area and its discharge.	The Project Proponent submitted that at conceptual stage, total 12 no.s of settling ponds will be developed and these will be strengthened by the stone pitching. About 6 numbers of earlier mined out abandoned pits and 12 nos of interlinked siltation ponds have been identified for collecting surface run off from respective catchment sub basins. The Project Proponent also submitted the map showing the settling ponds and drainage network and design of settling ponds. The Project Proponent submitted that a total of 5.49 Million CuM of void volume is available for surface run-offf holding in six pits having a cumulative area of 58.11 Ha which have a total catchment area of 160 Ha. During entire mine life water holding capacity of 5.49 or more than 5.49 Million CuM will be available at any time. Further, a total 12 nos of settling ponds have been earmarked within and outside the ML Area for collecting surface run off. A total of 0.38 Million M3 of void volume is available for surface run-offf holding in 12 nos settling ponds having a cumulative area of 8.84 Ha. Considering five fillings in a year, the gross volumes of settling ponds will be 1.90 Million M3.

Particulars	Details
Catchment area of pits	160 ha
Rainfall received	160 ha x 3500 mm = 5.6 Million CuM
Effective surface runoff to be accumulated in voids	5.6 x 0.7 = 3.92 Million CuM
Pits water holding capacity	5.49 Million CuM
Gross settling ponds capacity	1.90 Million CuM
Total water holding capacity of mined pits	7.39 Million CuM

and settling ponds	

Further, the Project Proponent submitted that since total water holding capacity in pits and settling ponds (7.39 Million CuM) is more than rainfall and surface runoff volume from catchment (3.92 Million CuM), there is sufficient space for effective surface runoff management in during extreme precipitation times. The dimensions of the drains to be maintained will be 2 m in width and 1.5 m in depth everywhere in the mine. A proper height will be maintained on the sides of the garland drain so that water does not get over-flooded from the drains. The available garland drains are 11313 m in length and daily average surface run-off is estimated as 14003 m3. The garland drains have capacity to accommodate instant volume of 33939 m3 as per above dimensions. Therefore, garland drains capacity is more than sufficient to take care of average daily surface run off during raining period. Additional drains are proposed to take care of peak run off during the plan period. Therefore, water management structures comprising of drains, settling ponds and mined out pits are available as well as planned to address the catchment area run-off for conceptual period. The overflow discharge water will be regularly monitored so that quality of water is maintained as per the prescribed standards and always clear water from ponds / pits meet the natural system. In case required, water treatment would be done in the pits by using lime and flocculants or other organic chemicals.

4

The Project Proponent needs to bypass the public road and also to explore the possibility of increasing the capacity of the trucks so as to reduce the no. of trips. The EAC opined that the Project Proponent needs to revisit the traffic load by considering the cycle time and waiting time. The Project Proponent needs to submit the action plan for strengthening the road and for converting the unpaved ro

The Project Proponent submitted the map showing the transportation route comprising of dedicated road corridor and public road. The total travel distance upto Jetty is 5.48 kms (4.54 km dedicated road and 0.94 km MDR-20 Public Road).Traffic load and effective distance between two trucks are as follows:-

S. No	Transportation working days	Quantity (In TPA)	Tonnes/ Day	Trips per day	Mode of transport
1	237	30,00,000	12658	1205	Road
	Total Trips per day			1205	

The Road width details for various segments are as follows:

Dedicated Road corridor		Public Road
3.31 km	1.23 km	0.94 km
12-15 mts wide Road	7 mts wide Road	7 mts wide Road

Further, the Project Proponent submitted the following details:-

1. Capacity of truck is 10.5 tons as per directives of Deptt. of Mines & Geology, Goa
2. Total Handling per day is 12658 tons /day
3. Transportation timings are 6.00 am to 7.00 am, 8:00 am to 12.45 pm and 2:00 pm to 5.45 pm. Therefore, the effective transportation time is 9.30 hrs.
4. Per Hour Handling is: 1332 tons/hour
5. No. of Vehicles per Hour (One way): 127 vehicles

Date of application	File No/ Proposal No	Consideration	Details	Date of accord
16.03.2023	F.No: IA-J-11015/3/2023-IA-II(NCM) IA/GA/MIN/422323/2023	3-4 May, 2023	Terms of Reference (ToR) to M/s Vedanta Limited for mining of Iron Ore in Bicholim Mineral Block – Block I (Auction Block) with proposed production capacity of 3.0 MTPA, Waste: 25.162 MTPA (Total Excavation: 28.162 MTPA) along with crushing and screening plant capacity of 4.0 MTPA in the mine lease area of 478.5206 ha, located in Bicholim, Bordem, Lamgao, Mulgoa, Mayem & Sirigao Villages of Bicholim Taluka of North Goa District, Goa	16.06.2023

v. Details of Mine Lease:

a) The Project Proponent has submitted the Letter of Intent (LoI) granted by the Government of Goa vide Lr No DMG/25/Auction Cell/LOI-function/2023/2801 dated 13.01.2023 for grant of mining leasefor Block I - Bicholim Mineral Block for Iron Ore in Bicholim, Bordem, Lamgao, Mulgao Mayem & Sirigao villages, Bicholim Taluka, North Goa District over an area of 478.5206 Hectare for a period of 50 (fifty) years in pursuant to Rule 10(2) of the Auction Rules. This letter of intent is valid for a period of 3 (three) years from the date of its issuance.

vi. Land Use/Land Cover of the Mine Lease Area:

Private land	421.1153 Ha
Government land	57.4053 Ha
Total Mining lease area (MLA)	478.5206 Ha
Private land for crusher, workshop & other infrastructure outside the MLA	Not Applicable

vii. Details of Mining Plan:

Review and Mining Plan approved by Indian Bureau of Mines, Goa	Letter No.	No. MCDR-MPC|1|2023-GOA-IBM_ RO_ GOA
	Date	26.05.2023
	Mine Lease Area	478.5206 Ha
	Mineral	Iron Ore (Major Mineral)
Mining Parameters	Quantitative Description	
Method of Mining	Opencast mechanized mining without Drilling & Blasting	
Drilling/Blasting	Not Applicable	
Total Reser	84.73 Million Tonnes	

ves and Res ources	
Proved Min eral Reserv e	36.071 Million Tonnes
Life of min e	30 years
Bench Heig ht	7 m
Bench Widt h	10 m
Individual b ench slope	700
Overall pit slope	<260
RoM output size	Less than 500 mm
Crushing S creening	Mobile Dry Crushing and Screening plant shall be available within the proposed mine to handle 4 MTPA of crude ore. The primary crusher will consist of 1 no. of Jaw crusher of capacity 120 TPH with an input feed of -500mm and shall produce output of -70 mm. It shall be followed by seconda ry crushers, 2 no.s of capacity 300 TPH and 200 TPH respectively. The input feed size shall be -70 mm and output feed size obtained shall be -40mm. The Screening Plants of capacity -600TPH shal l be installed where input the feed size shall be -70mm to obtain product of -40mm lumps & -10m m fines.
Transportati on details	ROM/Iron ore or Screened/crushed material will be transported by 10.5 Tonne trippers from Mine to Sarmanas jetty through a dedicated road. The total distance from the mine to Jetty is 5.58 km of which 0.94 km stretch is public road and remaining 4.64 km is company owned dedicated road.
Dumpers ca pacity	40 tonne (within mines)
Waste hand ling and Dis posal	During the mining period, the waste generated by mining will be temporarily stacked within the m ining lease area as surface dump and backfilled in the exhausted portion of the pits. The total wast e to be generated during the plan period is about 69.85 million tonnes. An area of 6.7146 Ha shall be utilized for Dumps and Material stocking at the conceptual stage of mining.

viii. Water requirement:

Total water req uirement	664 KLD	Pit Water	628 KLD
		Ground water	36 KLD
Source	Water from Mine Pit will be used for dust suppression, Vehicle washing and Green belt. Water for domestic requirement will be met from bore well.		

Permission	The Bore wells are registered with Goa State Water Resource department. Application for usi g mine pit water will be submitted.

IX. Nearest village / town/ highway/railway station / water bodies/monument:

Particulars	Particular's Name	Distance & Directions
Village	Lamgoa	Within the lease area
Town	Bicholim Town	0.5 km. East
Road	State Highway SH-1	0.65 km. East
Railway Station	Tivim Railwaystation	10.5 km. North
Water Bodies	Asnora River Mayem Lake Mandovi River	Touching lease boundary at one of the points 0.46 km 2.3 km. SW
School	Mulgao Govt. Primary School	Within the lease area
Worship places	Namuzgah/Idgah Shri Lairae Temple	Within the lease area 0.86 km
Caves Fort	300m buffer from Lamgao caves Khorjuvem Fort: 2 km	

X. Presence of Environmentally Sensitive areas in the study area

Forest Land Protected Area Environmental Sensitivity Zone	Yes No	Details of Certificate/letter Remarks
Forest Land	Yes	Mayem Forest Common Boundary with the mine lease area The following Reserve Forests are located within 10 km radius of the mine lease area such as Kharapal RF -6.7 km Kasarpal RF - 5.1 km Ambadgaon RF - 7.6 km
National park	No	The Project Proponent has submitted the letter from the Office of the Dy. Conservator of Forests vide Lr No: DCF(WP)/Tech/Digi/Vol-I/75/2022-23/ 968 dated 23.01.2023 stating that the proposed Bicholim Mineral Block-I is not situated within 10 km radius from the boundary of any the protected area in the State of Goa. PP also submitted the authenticated map dated 24.01.2023 showing the distance of the following Wildlife Sanctuary from the mine lease area. 1. Madei Wild life Sanctury-14.105 km. E 2. Salim Ali Bird Sanctuary -10.553 km, SW 3. Bondla Wild life Sanctuary -20.476 km, SE

Schedule-I species	Yes	The Project Proponent has submitted the letter from the Office of the Dy. Conservator of Forests vide Lr No: 5/FCA/GEN/F&F/DCFN/TECH/2022-23 dated 04.04.2023 with regard to list of Flora and Fauna species present in core and buffer zone. The following Schedule-I species are found in the study area such as 1 Common leopard (*Felidae*) 2 White-bellied Sea-Eagle(*Accipitridae*) 3 Indian Peafowl (*Phasianidae*) 4 Crimson rose- Butterfly (*Papilionidae*)
Status of Wildlife Conservation Plan	Yes	Wild Life Conservation Plan is prepared and submitted for approval of Chief Wildlife Warden (CWLW) on 19.06.2023. PP has submitted the copy of the acknowledgement from Chief Wildlife Warden.

xi. Green belt/plantation details:

Proposed area for green belt/plantation	105.8894 ha
Budget for green plant& plantation till the end of life of mine.	Rs159.0Lakhs
Particulars for Green belt/plantation	Area covered (in Ha)
7.5 m barrier & non-mineralized zone	25 ha
50 m safety zone of nallah, roads, electric lines	
Additional information (if any)	80.8894 ha (on backfilled area)

xii. Details of Baseline data:

Baseline Data (Air / Water / Noise / Soil / Ground water table/ others)	
Period of baseline data collection	March, 2023 to May, 2023
Season (Summer / Pre-monsoon / Post-monsoon / Winter)	Summer Season
Ambient Air Quality (no. of locations) and results	

No. of Locations	Parameters	Results
9	PM10	27.0 to 56.0 mg/m3
	PM2.5	14.0 to 36.0 mg/m3
	SO2	4.0 to 13.0 mg/m3
	NO2	<4.0 to 18.0 mg/m3

Noise level (no. of locations) and results	

No. of Locations	Parameters	Results
09	During Day Time [Leq dB(A)]	43.1 to 61.7
	During Night Time [Leq dB(A)]	35.9 to 49.3

Water Quality (no. of locations) and results

Surface water quality

No. of Locations	Parameters	Results
07	pH	6.35 - 7.39
	TDS (mg/l)	72 - 11240
	Fluoride (mg/l)	<0.1
	Chloride (mg/l)	18 - 5620
	Fe (mg/l)	<0.05
	Dissolved Oxygen (as O2), mg/l	6.2 – 6.9
	Biochemical Oxygen Demand (as O2), mg/l	<3.0
	Chemical Oxygen Demand (COD) mg/l	22.0 – 26.0

Groundwater Quality

No. of Locations	Parameters	Results
10	pH	5.63 – 7.07
	TDS (mg/l)	20 – 150

Fluoride (mg/l)	0.1
Chloride (mg/l)	5.0 - 19.0

Soil Quality (no. of locations) and results

No. of Locations	Parameters	Results
07	pH	5.38 to 5.78
	Electrical Conductivity (mohs/cm)	0.28 to 0.318
	Nitrogen (kg/ha)	200 to 275
	Phosphorus (kg/ha)	14.3 to 17.8
	Potassium (kg/ha)	230 to 263

xiii. Public Hearing (PH) Details:

Advertisement for PH with date	07.07.2023 Regional: Bhangar Bhui, Heraldo, Lokmat & Free press journal (Mumbai Edition) News papers
Date of PH	11/08/2023
Venue	Narayan Zantye Multipurpose Sports Complex, Sarvan, Bicholim, Goa
Chaired by	District Collector, North Goa
Main issues raised during PH	Pollution, impact on ponds, Support for Education, Health, Agriculture Development & Skill Development, Employment.
Budget proposed for addressing issues raised during PH	Rs 309.3 Lakhs

xiv. Rehabilitation & Resettlement:

R & R details	There is presence of habitation within ML Area at Mulgao and Iamgao villages. Safety Buffer of 50m will be maintained from the habitations. No Rehabilitation & Resettlement Plan is proposed during life of mine.

xv. Court case details:

Court Case	Yes
Additional information (if any)	First Case: 1. WP(Civil) 2478 of 2022 (Filing number) before the High Court of Bombay at Goa 2. The said writ petition has been filed against the State Government and seeks to challenge the identification of properties bearing survey no. 90/1(part) and 96/0 as part of the recently auctioned Bicholim mine. The petition alleges violation of Rule 5 &6 of Mineral Evidence Rules and Section 10B of MMDR, Act by the State of Goa and DMG. The petitioner has prayed for quashing of auction notice to the extend it includes the property of the petitioner and grant a writ of mandamus against the Respondents. 3. Case status is pending. 4. No adverse orders have been passed. 5. As per the last order the matter has been disposed of by the HC on 17th July 2023 with a direction to the Petitioner to make a representation before the Government and the Government is to dispose of the same within four months. Second Case: 1. WP 592 of 2022 The said writ petition seeks to challenge the constitutionality of the tender documents of Phase I auction of Goa mines. The petition alleges violation of Rule 5 & 6 of Mineral Evidence Rules by the State of Goa and DMG. The petition alleges non-disclosure of essential facts such as bore hole data, approved mining plan, production data of the previous five years and exploration data. The petitioner has prayed for quashing of auction notice to the extend it fails to include the essential facts and in the alternative to stay the auction. 1. Case status is pending 2. No adverse orders have been passed. 3. As per the last order the matter is listed on 01.09.2023.

xvi. Affidavit/Undertaking details:

Affidavit as per Ministry's OM dated 30.05.2018	The Project Proponent has submitted the Affidavit in a non-judicial stamp paper of Rs 100 bearing no: A807037 dated 24.04.2023 stating that they will comply to the directions issued by MoEF&CC vide Office Memorandum F.No.3-50/2017.IA.III (Pt) dated 30th May, 2018 in terms of directions given Hon'ble Supreme Court in judgment dated 2nd August 2017 in Writ Petition (Civil) No. 114 of 2014 in the matter of common cause versus Union of India & Ors.
Undertaking of Project Proponent	The Project Proponent has submitted an undertaking stating that the Environmental Impact Assessment Report of Block-1 Bicholim Mineral Block of M/s Vedanta Ltd was prepared by M/s Mineral Engineering Services, QCI/NABET Accredited EIA Consultant at Sr.No. 55 as per list of list of accredited consultant/organizations. The Project Proponent has submitted an undertaking that the information and data provided in the EIA report and submitted to the Ministry are factually correct and they are fully accountable for the same.
Consultant submitted an Undertaking vide letter dated 02.06.2023	This is to declare that the prescribed ToRs have been complied with and that the data submitted are factually correct in respect of EIA & EMP report prepared for Block-1 Bicholim Mineral Block of M/s Vedanta Ltd, Goa.

xvii. Details of the Environmental Management Plan (EMP):

Activities	Capital cost (Crores)	Recurring cost

		(Lakhs/annum)
Plantation	-	7.5
Environment monitoring	44	44
Air pollution control measures	20	300
Water Treatment	-	11
Erosion control /monsoon measures	-	221
Personal protective equipment	-	15
Maintenance of fire protection systems	-	1.5
Environment awareness & training	-	5
Health	8	16
Total	72	621

xviii. Details of project cost and employment:

Particulars	(Rs. In lakhs)
Project Cost	25000 Lakhs
Employment	716 no.s

3.5.3. Deliberations by the committee in previous meetings

Date of EAC 1 :22/09/2023

Deliberations of EAC I :

The Project Proponent and the Consultant presented the KML file to indicate the site features in the study area of 10 radius. The Project Proponent has shown the boundary of the mine lease area and informed the EAC that there are habitations such as Mulgao and Lumgao and schools are located within the mine lease area. Two schools are locate the Mulgao Village. One school is located at a distance of 138m from the Ultimate Pit Limit (UPL) and the other sch is located at a distance of 190m from the Ultimate Pit Limit (UPL). No drilling and blasting is involved. Green barr are maintained to prevent it from the environment hazards. Tributary of Asnora River is touching the mine lease area the western side. It has been observed that area between river & bottom pit 5 is approximately 6m AMSL whi obstructs the flow of water between them, even the high flood condition and at the place where river is touching t block boundary, it is 10.93m AMSL. Hence, even during high flood level, river will not interact with the pit water. Th EAC noted that there are few temples, caves and fort are present in the vicinity of the mine lease area. There will be n surface dumping and will be backfilled concurrently and there are voids available for backfilling. Later on the Projec Proponent has informed that the pits will be used as a settling ponds. The EAC noted that the Project Proponent giving two contradictory statements. The EAC asked the Project Proponent to provide the design of the settling ponds in different pits.

The Project Proponent has informed the EAC that Block-I Bicholim block is an old mine and it was auctioned to Vedanta Ltd in the year 2022 and Letter of Intent (LoI) was granted on 13.01.2023. The EAC asked the Project Proponent that after the year 2018 whether any Environmental Clearance has been granted in the State of Goa. The Project Proponent has informed the EAC after the year 2018 there was no mining in Goa and this instant case is the first case for grant of Environmental Clearance. No forest land is involved in the mine lease area. The EAC noted that the Project Proponent has submitted that Mayem Forest common boundary is sharing with the mine lease area. The EAC was of the view that involvement of forest land within the mine lease area is not clear as there are two contradictory information given by the Project Proponent. The EAC also noted that in this regard, the Project Proponent has not submitted the letter from the Forest Dept. No National Park/Wildlife Sanctuary, ESZ/ESA etc., is located within 10km radius of the study area. An application for Groundwater withdrawal was submitted to Water Resource Department submitted on 19.06.2023. No Rehabilitation and resettlement is involved in this proposal.

The Project Proponent has informed the EAC that ROM/Iron ore or Screened/crushed material will be transported by 10.5 Tonne trippers from mine to Sarmanas jetty through a dedicated road. The total distance from the mine to Jetty is 5.48 km of which 0.94 km stretch is public road and remaining 4.54 km is company owned dedicated road. Width of the road is 7.0m. Twenty four hours continuous volume count was manually undertaken during May-2023. The EAC noted that the width of the road is not adequate. About 1205 no. of trips per day will be carried out. No. of working days will be 365. The EAC was of the view that when the rainfall is 3500 mm/year it will be difficult to carry out mining for 365 days. The Project Proponent has informed the EAC that 275 working days are considered for calculation of traffic load. The EAC asked the Project Proponent to bypass the public road and also to explore the possibility of increasing the capacity of the truck so as to reduce the no. of trips. The EAC opined that the Project Proponent needs to revisit the traffic load by considering the cycle time and waiting time. The EAC also asked the Project Proponent to strengthen the road and convert the road into concrete road.

The Project Proponent also informed the EAC that the predominant wind direction was from West to East. Wildlife Conservation Plan has been prepared and submitted to Chief Wildlife Warden (CWLW) on 19.06.2023 for approval with a budget of Rs. 50 Lakhs. At the end of conceptual stage, an area of 105 ha will be under green belt/ plantation. Eco restoration will be carried out in similar to the reclaimed activity carried out in Sanquelim mine. Public hearing was carried out on 11.08.2023 and a budget of Rs 309.3 Lakhs have been earmarked to address the concerns raised during public hearing. The EAC also noted that about 4708 written objections was submitted against the project during the public hearing. The Project Proponent has informed the EAC that the issues are same but the no. of objection letters were more in number and about 5183 no.s of letters were also received in support of the project. The EAC also noted that many complaints were received against the public hearing dated 11.08.2023. The EAC asked the Project Proponent to submit the video recording of the public hearing. There are three court cases at present regarding the auction process and one of the court case was disposed on 17.07.2023 and will abide the directions of the Hon'ble High Court. Other two cases in the matter of MSPL v. State of Goa & Ors. in WP 592 of 2022 and in the matter of Suresh Govind Gaonkar & Ors v. Directorate of Mines and Geology & Ors. in PIL WP 2029/2023 (F) are pending before the Hon'ble High Court and no adverse orders has been passed.

The Department of Mines and Geology, Goa was invited as a special invitee to discuss the present status of mining in Goa. The Deputy Director has informed that the State Govt. is looking positive to restart the mining operations in Goa. Besides 10% DMF, there is also a scheme called Goa Iron Ore permanent fund wherein 10% of the sale value of the mineral will be spent towards community based activities as per the direction of the Hon'ble Supreme Court. The State Govt. has put up a scheme for approval before the Hon'ble Supreme Court in line with Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY) Scheme. This fund has to be kept for prosperity. The report with regard to illegal mining will be obtained from the SIT and will be provided to the Ministry.

After detailed deliberations made by the Project Proponent and the Consultant, the EAC noted that the handling waste of 25.162 MTPA will be more than the Iron Ore production capacity of 3.0 MTPA. The EAC was of the view that the pollution potential will be more in handling of waste. The EAC not convinced with plan for backfilling and with the design of settling ponds as the annual rainfall is projected as 3500 mm/year. The EAC observed that the instant mine is located in dense vegetation area. The EAC also noted that the mine lease area is located close to the proximity of the habitations, school, forest (Mayem common boundary), river, temples, caves and fort. The EAC also observed that the Project Proponent has not properly worked out the traffic load. Many litigations were received against the public hearing project. Further, the EAC also noted that mines were not in operation in Goa from the year 2018 and this instant proposal is a first case for grant of Environmental Clearance (EC) under auction after 5 years. Thus there is a need to ascertain the present scenario and ground reality with regards to handling of waste, settling ponds, location of waste dump w.r.t habitation, school and river, other surface features as forest (Mayem common boundary), temples, caves and fort, mineral transportation route and traffic congestion. The EAC was of the view that a site visit needs to be conducted by a sub-committee comprising of EAC Members and officers from MoEF&CC. The EAC opined that the Ministry may constitute a sub-committee and submit its report to enable the committee to take a decision on the proposal. Therefore, the EAC **deferred** the proposal for want of following additional information: -

i. The site visit report of the subcommittee.

ii. The Project Proponent needs to revisit the plan for backfilling with clearly indicating the voids area and the capacity available required for backfilling.

iii. The Project Proponent needs to submit the design of settling ponds by considering the annual rainfall, catchment area and its discharge.

iv. The Project Proponent needs to bypass the public road and also to explore the possibility of increasing the capacity of the truck so as to reduce the no. of trips. The EAC opined that the Project Proponent needs to revisit the traffic load by considering the cycle time and waiting time. The Project Proponent needs to submit the action plan for strengthening the road and for converting the unpaved road into concrete road.

v. Since the mine lease area is sharing the Mayem Forest common boundary, the Project Proponent needs to submit the letter from the State Forest Department regarding the involvement of forest land in the mine lease area.

vi. The Project Proponent needs to submit a letter from the Department of Geology and Mining, Government of Goa clarifying whether any illegal mining within the mine lease area has been carried out or not and whether the same has been carried out by M/s. Vedanta Limited or not?

vii. The Project Proponent needs to submit the video recording of the public hearing.

3.5.4. Deliberations by the EAC in current meetings

The Project Proponent presented the KML file to indicate the site features in the vicinity of the mine lease area. Then, the EAC deliberated on the additional details submitted by the Project Proponent and the EIA Consultant. The Project Proponent EIA Consultant informed the EAC that plan for backfilling has been revised. About 5 numbers of earlier mined out pits have been identified for backfilling purpose to accommodate waste to be generated in future besides additional pits to be made available progressively with mining till conceptual period. The existing and conceptual availability of voids for backfilling is 157.98 (say 158) million CuM. Conceptual waste generation shall be 124.9 million Cum which will have a swelled volume of 147.43 million CuM. The void area and the capacity available are more than sufficient to meet the backfilling requirement. The Project Proponent also presented the year wise production from the working pits and waste disposal locations. Further, the Project Proponent presented the Progressive Mine Closure Plan showing working pit, backfilling, drainages and settling ponds at the end of plan period.

The Project Proponent informed the EAC that a total of 0.38 million cu.m of void volume is available for holding surface run-off in 12 nos of settling ponds having a cumulative area of 8.84 ha. The EAC asked about the highest rainfall in the past. The Project Proponent informed the EAC that the highest rainfall was 3900mm in the last 10 years. The Project Proponent also informed the EAC that total water holding capacity in pits and settling ponds (7.39 Million Cu.M) is more than rainfall and surface runoff volume from catchment (3.92 Million Cu.M) and hence there is sufficient space for effective surface runoff management in during extreme precipitation times. It is also proposed to strengthen the existing settling ponds embankments by stone pitching, cement pointing, addition of filter beds etc., The total travel distance upto Jetty is 5.48 km comprising of 4.54 km dedicated road and 0.94 km MDR-20 Public Road.

Transportation working days will be 237 days. Trips per day will be 1205 and the capacity of the truck is 10.5 T (T). It is proposed to have a dedicated road in place of 0.94 km stretch of public road within 2.5 years. It is proposed to replace existing trucks of 10.5 t with higher capacity trucks of 25 t in phased manner to reduce traffic and emissions per tonne/km. The EAC suggested the Project Proponent to speed up the process of construction underpass. The Project Proponent presented a letter obtained from the Office of the Deputy Conservator of Forests dated 12.04.2023 stating that village wise Survey nos within Block-1 of Bicholim Mineral Block is not a Govt. For land and also does not identified as Private Forest land by State Level Expert Committee headed by Sawan/D Karapurkar/V.T. Thomas. The Project Proponent also informed the EAC that Goa State Pollution Control Board vi their letter dated 22/09/2023 submitted all the documents related to public hearing including public hearing video to th Member Secretary, EAC (Non Coal Mining).

Then, the Project Proponent presented the point wise compliance of the recommendations of the subcommitte The Project Proponent informed the EAC that preliminary techno-economic feasibility study has been undertaken for capacity of 3.0 MTPA from dry mineral processing plant to Sarmanas jetty covering a length of 5.72 km. Width of OLBC corridor is 17 m including service road. The proposed alignment for Over Land Belt Conveyor (OLBC) will be along the current transportation route. At prima facie it does not look feasible to switchover to OLBC system considering the terrain of the likely route having mounds and low-lying areas, vegetation/forest patches and its likely degradation, accessibility, environmental impacts and safety issues, technologies available, cost of the system, implementation period via-a-vis remaining reserves in the mining lease. Further, the Project Proponent also submitted that they will engage with all stake holders to explore the feasibility for installing conveyor belt system for transportation in near future. At conceptual stage, area of 20 ha will be converted into water reservoir &an area of 293.5 ha will be converted into backfilled area and will be reclaimed & rehabilitated by the plantation. The mined out pits will be converted into water reservoirs, pond with other ecotourism facilities like water sports, boating, fishing etc. Pisciculture in mine pits will be developed and also to involve the community for cage fishing to make it a commercially viable venture. It is proposed to develop theme-based gardens like medicinal gardens, horticulture gardens, spice gardens etc. A garden will be developed near the Idgah within the mining block area and proper road will be provided for access of visitors and pilgrims. The Project Proponent also presented the eco restoration model developed in other mines.

The Project Proponent informed the EAC that garland drain capacity is more than sufficient to take care of average daily surface run off during raining period. Additional drains are proposed to take care of peak run off during the plan period. A proper height will be maintained on the sides of the garland drain so that water does not get over-flooded from the drains. Permanent water sprinklers with 3.40 km length along the haul road within the mine lease area and 2.80 km length outside the mine lease area on either side of the road will be installed. Crushing & screening units will be modified within 4 months after obtaining the Clearances. It is proposed to develop nursery adjacent to the mineral block (Survey no 72/4 in Bicholim Village). Around 1100 sq.m of area will be utilized for the nursery.The Project Proponent informed the EAC that the authenticated list of Schedule I Species as per Indian Wildlife Protection Act 1972 as amended Gazette Notification of Wildlife (Protection) Amendment Act, 2022 has been obtained from the Dy. Conservator of Forests Wildlife & Eco-Tourism (North), Panji-Goa vide letter dated 27.11.2023 and according to this authenticated list, 29 Schedule I Species have been recorded within 10 km study area. The conservation activities proposed under Wildlife Conservation Plan has been revised with a budget of Rs 60.0 Lakhs and same will be finalized after discussion with the Forest Dept. A silt load study was carried out through Center for Advance studies,Department of Geology, University of Delhi and it was concluded that, all the structures made for the settling of sediments are found to be more than sufficient to accommodate sediments even during peak rainfall.

The Project Proponent informed the EAC that a letter was obtained from the Directorate of Mines & Geology vide letter dated 25.07.2023 stating that matter of illegal mining in the State of Goa is under investigation by the Special Investigation Team (SIT). The EAC asked the Project Proponent to submit the undertaking regarding illegal mining The Project Proponent submitted an undertaking vide email dated 26.12.2023 stating that M/s Vedanta limited is the preferred bidder for the Bicholim Mineral Block- Block 1 declared by the Govt. of Goa and it is also to undertake that there is no illegal mining done by M/s Vedanta ltd. The EAC opined that the instant Environmental Clearance (EC) is subject to the outcome of the WP 592 of 2022(MSPL v. State of Goa & Ors.) regarding challenging the constitutionality of the tender documents of Phase I auction of Goa mines and PIL WP 2029/2023 (F) (Suresh Govind Gaonkar & Ors v Directorate of Mines and Geology & Ors) regarding challenging the state's decision to go ahead with the auction of the mining block.

After detailed deliberations made by the Project Proponent and the EIA Consultant, the EAC in its meeting held during 26-28 December, 2023 under the provisions of EIA Notification 2006 and its subsequent amendments, **recommended** the proposal for grant of Environmental Clearance (EC) to Bicholim Mineral Block- Block 1 (Auction Block) of M/s Vedanta Limited for mining of Iron Ore with proposed production capacity of 3.0 MTPA, Waste: 25.162 MTPA(Total Excavation: 28.162 MTPA) along with crushing and screening plant capacity of 4.0 MTPA in the mine lease area of 478.5206 ha, located at Bicholim, Bordem, Lamgao, Mulgoa, Mayem & Sirigao Villages of Bicholim Taluka of North Goa District, Goasubject to the following specific conditions in addition to the standard EC conditions applicable for non-coal mining projects: -

Recommendation of EAC

commended

6. Details of Environment Conditions

6.1. Specific

Air Pollution	
1.	As committed by the Project Proponent, existing trucks of 10.5 Tonnes shall be replaced with higher capacity trucks of 25 Tonnes in phased manner to reduce traffic load and emissions per tonne/km.
2.	Fugitive dust monitoring during transportation shall be monitored regularly at all the sensitive receptors and report shall be submitted quarterly to the Regional Office of MoEF&CC. Regular sprinkling shall be done on roads to suppress the dust at the source.
3.	The Project Proponent needs to install the permanent water sprinklers along 3.40 km haul road within the ML area and 2.80 km length outside the ML area on either side of the road.
4.	The Project Proponent shall adhere to the pollution control measures suggested by the Central Pollution Control Board (CPCB) in the environmental guidelines for crushing/screening activity.
Awareness on Single Use Plastic (SUP)	
1.	The Project Proponent shall create awareness among the local people working within the project area as well as its surrounding area on the ban of Single Use Plastic (SUP) in order to ensure the compliance of Notification published by MoEF&CC on 12/08/2021. A report, along with photographs, on the measures taken shall also be included in the six monthly compliance report.
Capping	
1.	The Hon'ble Supreme Court has imposed a capping on mining of iron ore to 20 MTPA for the entire State of Goa. Accordingly, the Project Proponent shall first obtain the necessary permission from the competent authority with regard to the amount of mineral they can mine per year, before starting its mining operation.
Cleaner production	
1.	The Project Proponent shall explore the possibility of using atleast 20% of Electric vehicles/CNG/Solar instead of diesel operation within three years.
Common boundary	
1.	The Project Proponent needs to obtain prior permission from the MoEF&CC for mining in common boundary as and when required.
Conservation of Wildlife	
1.	The Project Proponent needs to use modern equipment's such as Camera Traps for ensuring presence and movement of wild animals in the vicinity of the mine lease area as well as in study area in consultation with Wildlife Wing of Forest Department. Appropriate interventions shall be taken to minimise stress conditions for wild animals and to avoid Man-Animal conflict.
2.	The Project Proponent needs to explore the possibility of using advanced/ latest mining technologies available so

	as to minimize the ecological impacts.
3.	The Project Proponent should follow-up the status of implementation on Wildlife Conservation Plan from Forest Officials and the same shall be submitted to the Ministry's Regional Office in the six monthly compliance report.
Continuous Ambient Air Quality Monitoring System (CAAQMS)	
1.	The Continuous Ambient Air Quality Monitoring Stations (CAAQMS) shall be installed and commissioned in consultation with CPCB. The real time data so generated should be displayed digitally at entry and exit gate of mine lease area for public display and shall be linked to server of CPCB/SPCB.
Conveyor Belt	
1.	As committed before the EAC, the Project Proponent needs to explore the feasibility for installing conveyor belt system for transportation.
Court Case	
1.	The instant Environmental Clearance (EC) is subject to the outcome of the WP 592 of 2022 (MSPL v. State of Goa & Ors.) regarding challenging the constitutionality of the tender documents of Phase I auction of Goa mines and PIL WP 2029/2023 (F) (Suresh Govind Gaonkar & Ors v. Directorate of Mines and Geology & Ors) regarding challenging the state's decision to go ahead with the auction of the mining block.
Crushing/Screening	
1.	The Project Proponent needs to modify the crushing & screening units within 4 months from the date of issue of this EC.
Ecology Restoration	
1.	The ecology restoration or mine reclamation activities shall be carried out concurrently with mining operations. The Project Proponent shall ensure that the restoration models demonstrated before the EAC shall be developed in association with research institutes like NEERI, Goa University etc.
2.	The mined out pits will be converted into water reservoirs, pond with other ecotourism facilities like water sports, boating, fishing etc., Pisciculture in mine pits will be developed and also the local community will be involved for cage fishing to make it a commercially viable venture.
Environment Monitoring & Reporting	
1.	The Project Proponent shall monitor the air quality, noise level, water quality, water level and ground vibration during drilling and blasting at the edge of the mine, near the village, crusher and at other sensitive receptors and such collected data shall be submitted quarterly to the Ministry's Regional Office.
Green belt and Plantation	
1.	The Project Proponent needs to complete the entire peripheral plantation under green belt, safety barrier plantation and gap plantation within three years from the start of mining operations. The Project Proponent should plant quality sapling of appropriate height of native and fruit bearing species. In case of tall transplants (seedlings) the seedlings should have proper trained root stock with root biomass commensurate with seedling height to ensure good growth after out planting. Plantation shall be undertaken in consultation with the State Forest Department. The Project Proponent shall make the actual count on the saplings planted and its survival rate and in case of failure of achievement of 95% survival rate, action plan for achieving the target survival rate shall be submitted to the Ministry's Regional Office.

	Extensive native fruit bearing plantation shall be carried out in all safety zones with density of 2500 trees/ha.
Implementation of EMP	
1.	The Project Proponent should adopt the proper mitigation measures as proposed under EMP with budgetary provision of Rs 72 Cr. The adoption of mitigation measures and monitoring of the same as proposed in the EMP shall be done under the supervision of the qualified environmental personnel. The implementation status of the same shall be submitted to the Ministry's Regional Office.
2.	The Project Proponent should establish in house (at project site) environment laboratory for measurement of environment parameter with respect to air quality and water (surface and ground). A dedicated team to oversee environment management shall be setup at site which should comprise of Environment Engineers, Laboratory chemist and staff for monitoring of air, water quality parameters on routine basis instead of engaging environment monitoring laboratories/consultants. Any non-compliance or infringement should be reported to the concerned authority.
Nursery	
1.	The Project Proponent needs to develop a nursery adjacent to the mineral block (Survey no 72/4 in Bicholim Village) for an area of about 1100 sq.m in consultation with State Forest Department. PP shall develop theme-based gardens like medicinal gardens, horticulture gardens, spice gardens etc.,
Occupational health checkup	
1.	The Project Proponent should periodically monitor and maintain the health records of the mine workers digitally prior to mining operations, at the time of operation of mine and post mining operations. Regular surveillance on occupational health shall be carried out every year for mine workers. PP shall also organize medical camp for the benefit of the local people and also the monitor the health impacts due to mining activity.
Permission for Groundwater withdrawal	
1.	NoC from the Central Ground Water Authority (CGWA)/ Concerned Local authority, as the case may be, shall be obtained before drawing the ground water for the project activities, State Pollution Control Board / Pollution Control Committees shall not issue the Consent to Operate (CTO) under Air (Prevention and Control of Pollution) Act and Water (Prevention and Control of Pollution) Act till the project proponent shall obtain such permission.
Public Hearing concerns	
1.	The budget of Rs 309.3 Lakhs to address the concerns raised by the public in the public consultation to be completed within 3 years from the date of start of mining operations. PP shall comply with all action plans made for public hearing concerns and make regular maintenance and record the progressive activity outcomes. The Project proponent shall ensure that the activities proposed under the public hearing is different from the CSR activities.
Regrassing	
1.	
Settling pond	
1.	The Project Proponent needs to strengthen the settling pond with proper stone pitching in line with the design of settling pond considering the annual rainfall, flow rate, catchment area and its discharge.
2.	The catch drains and siltation ponds needs to be regularly maintained to arrest silt and sediments flow from dumps.
Soil erosion	

1.	The waste dump slopes shall be covered with laterite material and then with biodegradable geotextile mat prevent the soil erosion of the dump slopes so as to facilitate the growth of native species.
Surface water monitoring	
1.	Regular monitoring and analysis of discharge water and at upstream and downstream of Bicholim and Asnora river needs to be carried out quarterly through NABL/MoEF&CC accredited laboratory.
Training program	
1	The Project Proponent shall also organize employment-based apprenticeship/ internship training program every year with appropriate stipend for the youth and other programs to enhance the skill of the local people. The data should be maintained for the training imparted to the persons and the outcome of the training, for the assessment of the training program should be analyzed periodically and improved accordingly. The preference shall be given to the local people for the purpose of employment as committed before the EAC.
Underpass	
1.	The Project Proponent needs to speed up the process of construction of underpass.
Wheel Washing	
1.	The wheel washing facility for the ore transport vehicles shall be provided at the exit point of the mine.

3.5.6.2. Standard

1(a)	**Mining of minerals**
Air quality monitoring and preservation	
1.	Effective safeguard measures for prevention of dust generation and subsequent suppression (like regular water sprinkling, metalled road construction etc.) shall be carried out in areas prone to air pollution wherein high levels of PM10 and PM2.5 are evident such as haul road, loading and unloading point and transfer points. The Fugitive dust emissions from all sources shall be regularly controlled by installation of required equipments, machineries and preventive maintenance. Use of suitable water-soluble chemical dust suppressing agents may be explored for better effectiveness of dust control system. It shall be ensured that air pollution level conform to the standards prescribed by the MoEFCC/ Central Pollution Control Board.
1.	The Project Proponent shall install a minimum of 3 (three) online Ambient Air Quality Monitoring Stations with 1 (one) in upwind and 2 (two) in downwind direction based on long term climatological data about wind direction such that an angle of 120° is made between the monitoring locations to monitor critical parameters, relevant for mining operations, of air pollution viz. PM10, PM2.5, NO2, CO and SO2 etc. as per the methodology mentioned in NAAQS Notification No. B-29016/20/90/PCI/I, dated 18.11.2009 covering the aspects of transportation and use of heavy machinery in the impact zone. The ambient air quality shall also be monitored at prominent places like office building, canteen etc. as per the site condition to ascertain the exposure characteristics at specific places. The above data shall be digitally displayed within 03 months in front of the main Gate of the mine site.
Corporate Environment Responsibility (CER)	
1.	The Project Proponent shall submit the time- bound action plan to the concerned regional office of the Ministry within 6 months from the date of issuance of environmental clearance for undertaking the activities committed during public consultation by the project proponent and as discussed by the EAC, in terms of the provisions of the MoEF&CC Office Memorandum No.22-65/2017-IA III dated 30 September, 2020. The action plan shall be implemented within three years of commencement of the project.

Green Belt	
1.	The Project Proponent shall develop greenbelt in 7.5m wide safety zone all along the mine lease boundary as per the guidelines of CPCB in order to arrest pollution emanating from mining operations within the lease. The whole Green belt shall be developed within first 5 years starting from windward side of the active mining area. The development of greenbelt shall be governed as per the EC granted by the Ministry irrespective of the stipulation made in approved mine plan.
Land reclamation	
1.	Catch drains, settling tanks and siltation ponds of appropriate size shall be constructed around the mine working, mineral yards and Top Soil/OB/Waste dumps to prevent run off of water and flow of sediments directly into the water bodies (Nallah/ River/ Pond etc.). The collected water should be utilized for watering the mine area, roads, green belt development, plantation etc. The drains/ sedimentation sumps etc. shall be de-silted regularly, particularly after monsoon season, and maintained properly.
1.	Check dams of appropriate size, gradient and length shall be constructed around mine pit and OB dumps to prevent storm run-off and sediment flow into adjoining water bodies. A safety margin of 50% shall be kept for designing of sump structures over and above peak rainfall (based on 50 years data) and maximum discharge in the mine and its adjoining area which shall also help in providing adequate retention time period thereby allowing proper settling of sediments/ silt material. The sedimentation pits/ sumps shall be constructed at the corners of the garland drains.
1.	The Overburden (O.B.), waste and topsoil generated during the mining operations shall be stacked at earmarked OB dump site(s) only and it should not be kept active for a long period of time. The physical parameters of the OB / waste dumps / topsoil dump like height, width and angle of slope shall be governed as per the approved Mining Plan and the guidelines/circulars issued by D.G.M.S. The topsoil shall be used for land reclamation and plantation.
1.	The slope of dumps shall be vegetated in scientific manner with suitable native species to maintain the slope stability, prevent erosion and surface run off. The selection of local species regulates local climatic parameters and help in adaptation of plant species to the microclimate. The gullies formed on slopes should be adequately taken care of as it impacts the overall stability of dumps. The dump mass should be consolidated with the help of dozer/ compactors thereby ensuring proper filling/ leveling of dump mass. In critical areas, use of geo textiles/ geo-membranes / clay liners / Bentonite etc. shall be undertaken for stabilization of the dump.
Mining plan	
1.	The land-use of the mine lease area at various stages of mining scheme as well as at the end-of-life shall be governed as per the approved Mining Plan. The excavation vis-à-vis backfilling in the mine lease area and corresponding afforestation to be raised in the reclaimed area shall be governed as per approved mining plan. PP shall ensure the monitoring and management of rehabilitated areas until the vegetation becomes self-sustaining. The compliance status shall be submitted half-yearly to the MoEFCC and its concerned Regional Office.
1.	The Project Proponent shall adhere to approved mining plan, inter alia, including, total excavation (quantum of mineral, waste, over burden, inter burden and top soil etc.); mining technology; lease area; scope of working (method of mining, overburden & dump management, O.B& dump mining, mineral transportation mode, ultimate depth of mining, concurrent reclamation and reclamation at mine closure; land-use of the mine lease area at various stages of mining scheme as well as at the end-of-life; etc.).
Miscellaneous	
1.	Any appeal against this environmental clearance shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.
1.	The above conditions will be enforced inter-alia, under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986 and the Public Liability Insurance Act, 1991 along with their amendments and rules made there under and

	also any other orders passed by the Hon'ble Supreme Court of India/High Court and any other Court of Law relating to the subject matter.
1.	Concealing factual data failure to comply with any or submission of false/ fabricated data and of the conditions mentioned above may result in withdrawal of this clearance and attract action under the provisions of Environment (Protection) Act, 1986.
1.	The Ministry or any other competent authority may alter/modify the above conditions or stipulate any further condition in the interest of environment protection.
1.	In pursuant to Ministry's O.M No 22-34/2018-IA.III dated 16.01.2020 to comply with the direction made by Hon'ble Supreme Court on 8.01.2020 in W.P. (Civil) No 114/2014 in the matter Common Cause vs Union of India, the mining lease holder shall after ceasing mining operations, undertake regrassing the mining area and any other area which may have been disturbed due to other mining activities and restore the land to a condition which is fit for growth of fodder, flora, fauna etc.
1.	The concerned Regional Office of the MoEF&CC shall randomly monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the MoEF&CC officer(s) by furnishing the requisite data / information / monitoring reports.
1.	A separate 'Environmental Management Cell' with suitable qualified manpower should be set-up under the control of a Senior Executive. The Senior Executive shall directly report to Head of the Organization. Adequate number of qualified Environmental Scientists and Mining Engineers shall be appointed and submit a report to RO, MoEF&CC.
1.	The Project Authorities should inform to the Regional Office regarding date of financial closures and final approval of the project by the concerned authorities and the date of start of land development work.
1.	The Project Proponent shall submit six monthly compliance reports on the status of the implementation of the stipulated environmental safeguards to the MOEFCC & its concerned Regional Office, Central Pollution Control Board and State Pollution Control Board.
1.	The Project Proponent shall prepare digital map (land use & land cover) of the entire lease area once in five years purpose of monitoring land use pattern and submit a report to concerned Regional Office of the MoEF&CC.
Noise and vibration monitoring and prevention	
1.	The illumination and sound at night at project sites disturb the villages in respect of both human and animal population. Consequent sleeping disorders and stress may affect the health in the villages located close to mining operations. Habitations have a right for darkness and minimal noise levels at night. PPs must ensure that the biological clock of the villages is not disturbed; by orienting the floodlights/ masks away from the villagers and keeping the noise levels well within the prescribed limits for day /night hours.
1.	The peak particle velocity at 500m distance or within the nearest habitation, whichever is closer shall be monitored periodically as per applicable DGMS guidelines.
1.	The Project Proponent shall take measures for control of noise levels below 85 dBA in the work environment The workers engaged in operations of HEMM, etc. should be provided with ear plugs /muffs. All personnel including laborers working in dusty areas shall be provided with protective respiratory devices along with adequate training, awareness and information on safety and health aspects. The PP shall be held responsible in case it has been found that workers/ personals/ laborers are working without personal protective equipment.
Public hearing and human health issues	
1.	Project Proponent shall make provision for the housing for workers/labors or shall construct labor camps within/outside (company owned land) with necessary basic infrastructure/ facilities like fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche for kids etc. The housing may be provided

	in the form of temporary structures which can be removed after the completion of the project related infrastructure. The domestic waste water should be treated with STP in order to avoid contamination of underground water.

Statutory compliance

1.	This Environmental Clearance (EC) is subject to orders/ judgment of Hon'ble Supreme Court of India, Hon'ble High Court, Hon'ble NGT and any other Court of Law, Common Cause Conditions as may be applicable.
1.	The Project proponent complies with all the statutory requirements and judgment of Hon'ble Supreme Court dated 2nd August, 2017 in Writ Petition (Civil) No. 114 of 2014 in matter of Common Cause versus Union of India &Ors before commencing the mining operations.
1.	The State Government concerned shall ensure that mining operation shall not be commenced till the entire compensation levied, if any, for illegal mining paid by the Project Proponent through their respective Department of Mining & Geology in strict compliance of Judgment of Hon'ble Supreme Court dated 2nd August, 2017 in Writ Petition (Civil) No. 114 of 2014 in matter of Common Cause versus Union of India & Ors.
1.	The Project Proponent shall follow the mitigation measures provided in MoEFCC's Office Memorandum No. Z-11013/57/2014-IA.II (M), dated 29th October, 2014, titled "Impact of mining activities on Habitations-Issues related to the mining Projects wherein Habitations and villages are the part of mine lease areas or Habitations and villages are surrounded by the mine lease area".
1.	A copy of EC letter will be marked to concerned Panchayat / local NGO etc. if any, from whom suggestion / representation has been received while processing the proposal.
1.	State Pollution Control Board/Committee shall be responsible for display of this EC letter at its Regional office, District Industries Centre and Collector's office/ Tehsildar's Office for 30 days.
1.	The Project Authorities should widely advertise about the grant of this EC letter by printing the same in at least two local newspapers, one of which shall be in vernacular language of the concerned area. The advertisement shall be done within 7 days of the issue of the clearance letter mentioning that the instant project has been accorded EC and copy of the EC letter is available with the State Pollution Control Board/Committee and web site of the Ministry of Environment, Forest and Climate Change (www.parivesh.nic.in). A copy of the advertisement may be forwarded to the concerned MoEFCC Regional Office for compliance and record.
1.	The Project Proponent shall inform the MoEF&CC for any change in ownership of the mining lease. In case there is any change in ownership or mining lease is transferred. PP needs to apply for transfer of EC as per provisions of the para 11 of EIA Notification, 2006 as amended from time to time.

Transportation

1.	The Main haulage road within the mine lease should be provided with a permanent water sprinkling arrangement for dust suppression. Other roads within the mine lease should be wetted regularly with tanker-mounted water sprinkling system. The other areas of dust generation like crushing zone, material transfer points, material yards etc. should invariably be provided with dust suppression arrangements. The air pollution control equipments like bag filters, vacuum suction hoods, dry fogging system etc. shall be installed at Crushers, belt-conveyors and other areas prone to air pollution. The belt conveyor should be fully covered to avoid generation of dust while transportation. PP shall take necessary measures to avoid generation of fugitive dust emissions.
1.	No Transportation of the minerals shall be allowed in case of roads passing through villages/ habitations. In such cases, PP shall construct a 'bypass' road for the purpose of transportation of the minerals leaving an adequate gap (say at least 200 meters) so that the adverse impact of sound and dust along with chances of accidents could be mitigated. All costs resulting from widening and strengthening of existing public road network shall be borne by the PP in consultation with nodal State Govt. Department. Transportation of minerals through road movement in case of existing village/ rural roads shall be allowed in consultation with nodal State Govt. Department only after required strengthening such that the carrying capacity of roads is increased to handle the traffic load. The pollution due to transportation load on the environment will be effectively controlled

	and water sprinkling will also be done regularly. Vehicular emissions shall be kept under control and regularly monitored. Project should obtain Pollution Under Control (PUC) certificate for all the vehicles from authorized pollution testing centers. [If applicable in case of road transport].
Water quality monitoring and preservation	
I.	In case, immediate mining scheme envisages intersection of ground water table, then Environmental Clearance shall become operational only after receiving formal clearance from CGWA. In case, mining operation involves intersection of ground water table at a later stage, then PP shall ensure that prior approval from CGWA and MoEFCC is in place before such mining operations. The permission for intersection of ground water table shall essentially be based on detailed hydro-geological study of the area.
I.	The Project Proponent shall undertake regular monitoring of natural water course/ water resources/ springs and perennial nallahs existing/ flowing in and around the mine lease including upstream and downstream. Sufficient number of gullies shall be provided at appropriate places within the lease for management of water. The parameters to be monitored shall include their water quality vis-à-vis suitability for usage as per CPCB criteria and flow rate. It shall be ensured that no obstruction and/ or alteration be made to water bodies during mining operations without justification and prior approval of MoEFCC. The monitoring of water courses/ bodies existing in lease area shall be carried out four times in a year viz. pre- monsoon (April May), monsoon (August), post-monsoon (November) and winter (January) and the record of monitored data may be sent regularly to Ministry of Environment, Forest and Climate Change and its Regional Office, Central Ground Water Authority and Regional Director, Central Ground Water Board, State Pollution Control Board and Central Pollution Control Board. Clearly showing the trend analysis on six-monthly basis.
I.	Project Proponent shall regularly monitor and maintain records w.r.t. ground water level and quality in and around the mine lease by establishing a network of existing wells as well as new piezo-meter installations during the mining operation in consultation with Central Ground Water Authority/ State Ground Water Department. The Report on changes in Ground water level and quality shall be submitted on six-monthly basis to the Regional Office of the Ministry, CGWA and State Groundwater Department / State Pollution Control Board.
I.	The water balance/water auditing shall be carried out and measure for reducing the consumption of water shall be taken up and reported to the Regional Office of the MoEF&CC and State Pollution Control Board/Committee.
I.	Industrial waste water (workshop and waste water from the mine) should be properly collected and treated so as to conform to the notified standards prescribed from time to time. The standards shall be prescribed through Consent to Operate (CTO) issued by concerned State Pollution Control Board (SPCB). The workshop effluent shall be treated after its initial passage through Oil and grease trap.
I.	Project Proponent shall plan, develop and implement rainwater harvesting measures on long term basis to augment ground water resources in the area in consultation with Central Ground Water Board/ State Groundwater Department. A report on amount of water recharged needs to be submitted to Regional Office MoEFCC annually.
I.	Quality of polluted water generated from mining operations which include Chemical Oxygen Demand (COD) in mines run-off; acid mine drainage and metal contamination in runoff shall be monitored along with Total Suspended Solids (TDS), Dissolved Oxygen (DO), pH and Total Suspended Solids (TSS). The monitored data shall be uploaded on the website of the company as well as displayed at the project site in public domain, on a display board, at a suitable location near the main gate of the Company. The circular No. J- 20012/1/2006-IA.II (M) dated 27.05.2009 issued by Ministry of Environment, Forest and Climate Change may also be referred in this regard.
null	
I.	The Project Proponent shall carryout plantation/ afforestation in backfilled and reclaimed area of mining lease, around water body, along the roadsides, in community areas etc. by planting the native species in consultation with the State Forest Department/ Agriculture Department/ Rural development department/ Tribal Welfare Department/ Gram Panchayat such that only those species be selected which are of use to the local people. The

	CPCB guidelines in this respect shall also be adhered. The density of the trees should be around 2500 saplings per Hectare. Adequate budgetary provision shall be made for protection and care of trees.
1.	The Project Proponent shall make necessary alternative arrangements for livestock feed by developing grazing land with a view to compensate those areas which are coming within the mine lease. The development of such grazing land shall be done in consultation with the State Government. In this regard, Project Proponent should essentially implement the directions of the Hon'ble Supreme Court with regard to acquisition of grazing land. The sparse trees on such grazing ground, which provide mid-day shelter from the scorching sun, should be scrupulously guarded/ protected against felling and plantation of such trees should be promoted.

Day 2 -27/12/2023

3.1. Agenda Item No 1:

3.1.1. Details of the proposal

Proposed 3C2 Limestone Block (Auctioned Block) (Area 386.0215 Ha.) with Limestone Production Capacity: 2.50 Million TPA, OB/IB/Waste: 2.80 Million TPA, Top Soil: 0.38 Million TPA (Total Excavation: 5.68 Million TPA) along with Installation of Crusher 1600 TPH with Wobbler located at Villages: Harima & Deh, Tehsil: Nagaur & Deh, District: Nagaur, Rajasthan. by M/s. JSW Cement Ltd. by MANOJ RUSTAGI located at NAGAUR,RAJASTHAN

Proposal For		Fresh ToR	
Proposal No	**File No**	**Submission Date**	**Activity (Schedule Item)**
IA/RJ/MIN/451760/2023	IA-J-11015/49/2023-IA-II(NCM)	27/11/2023	Mining of minerals (1(a))

3.1.2. Project Salient Features

The instant proposal is for mining of Limestone in 3C2 Limestone Block (Auctioned Block) of M/s. JSW Cement Ltd with proposed Limestone Production Capacity: 2.50 Million TPA, OB/IB/Waste: 2.80 Million TPA, Top Soil: 0.38 Million TPA (Total Excavation: 5.68 Million TPA) along with Installation of Crusher 1600 TPH with Wobbler in the mine lease area of 386.0215 Ha, located at Villages: Harima &Deh, Tehsil: Nagaur&Deh, District: Nagaur, Rajasthan.

2. The details of the project as ascertained from the document submitted by the Project Proponent and revealed from the discussions held during the meeting are given as under: -

i. The proposed project activity is listed at schedule no. 1(a) Mining of Minerals and falls under Category "A" of the schedule of the EIA Notification, 2006 as the mine lease area is greater than 250 ha and appraised at the Central level.

ii. The mine lease area is located between Latitude: 27°16'25.15"N to 27°17'21.393"N and Longitude: 73°52'31.652"E to 73°53'54.28"E. The mine lease area falls under the Survey of India Toposheet No: G43B15 (45E/15) and falls in Seismic Zone-II.

iii. Details of Mine Lease:

S. no	Prospecting License/ Letter of Intent (LoI)/ Grant of Mine lease and Lr No	Date of the grant	Name of the Mineral & (Major/ Minor)	Period of Grant	Granted by	Mine lease area in Ha
1.	Letter of Intent (LoI) for grant of mining lease issued vide letter no. P.2(21) Khan/Group-2/2022 through e-auction process	15.11.2022	Limestone	3 years	Govt. of Rajasthan	386.0215

iv. Land Use/Land Cover of the Mine Lease area:-

Private land	292.3618 ha

No. Z-11013/57/2014-IA.II (M)
Government of India
Ministry of Environment, Forests and Climate Change
Impact Assessment Division
****

Indira Paryavaran Bhavan,
Jor Bagh Road, Aliganj,
New Delhi-110 003

Dated: 29th October, 2014

OFFICE MEMORANDUM

Subject: Impact of mining activities on Habitations-Issues related to the mining Projects wherein Habitations and villages are the part of mine lease areas or Habitations and villages are surrounded by the mine lease area- Regarding.

The Ministry has been receiving mining proposals wherein the habitations and villages are part of mine lease areas or habitations and villages are surrounded by the mine lease area.

2. To discuss the impact of mining activities on habitations and to develop a code of practice on these issues, a meeting was held under the Chairmanship of Shri M.S. Nagar, Chairman EAC (Non Coal Mining Sector) on 23.06.2014. After detailed deliberations by the Experts, the following suggestions were made as part of mitigation measures to avoid adverse impact of mining operations in the case of such habitations/villages:-

a) The Project Authority shall adopt Best Mining Practice for the given mining conditions. In the mining area, adequate number of check dams, retaining walls/structures, garland drains and settling ponds should be provided to arrest the wash-off with rain water in catchment area.

b) The natural water bodies and or streams which are flowing in and around the village should not be disturbed. The Water Table should be nurtured so as not to go down below the pre-mining period. In case of any water scarcity in the area, the Project Authorities have to provide water to the villagers for their use. A provision for regular monitoring of water table in open dug well located in village should be incorporated to ascertain the impact of mining over ground water table.

c) The illumination and sound at night at project sites disturb the villages in respect of both human and animal population. Consequent sleeping disorders and stress may affect the health in the villages located close to mining operations. Habitations have a right for darkness and minimal noise levels at night. The Project Proponents (PPs) must ensure that the biological clock of the villagers is not disturbed by orienting the floodlights/ masks away from the villages and keeping the noise levels well within the prescribed limits for day/night hours.

d) The Project Authority shall make necessary alternative arrangements, where required, in consultation with the State Government to provide alternate areas for livestock grazing. In this context, Project Authority should implement the directions of the Hon'ble Supreme Court with regard to acquiring grazing land. The sparse trees on such grazing ground, which provide mid-day shelter from the scorching sun should be scrupulously guarded against felling, lest the cattle abandon the grazing ground or return home by noon.

e) Where ever blasting is undertaken as part of mining activity, the Project Authority shall carry out vibration studies well before approaching any such habitats or other buildings to evaluate the zone of influence and impact of blasting on the neighbourhood. Within 500 meters of such sites vulnerable to blasting vibrations, avoidance of use of explosives and adoption of alternative means of mineral extraction, such as ripper/dozer combination/rock breakers/ surface miners etc. should be seriously considered and practiced wherever practicable. A provision for monitoring of each blast should be made so that the impact of blasting on nearby habitation and dwelling units could be ascertained. The covenant of lease deed under Rule 31 of MCR 1960 provides that no mining operations shall be carried out within 50 meters of public works such as public roads and buildings or inhabited sites except with the prior permission from the Competent Authority.

f) Main haulage road in the mine should be provided with permanent water sprinklers and other roads should be regularly wetted with water tankers fitted with sprinklers. Crusher and material transfer points should invariably be provided with Bag filters and or dry fogging system. Belt-conveyors should be fully covered to avoid air borne dust.

g) The Project Authority shall ensure that the productivity of agricultural crops is not affected due to mining operations. Crop Liability Insurance Policy has to be taken by the PP as a precaution to compensate for any crop loss. The impact zone shall be 5km from the boundary of mine lease area for such insurance policy. In case, several mines are located in a cluster, the Associations of owners of the cluster mines, formed inter-alia, to sub-serve such an objective, shall take responsibility for securing such Crop Liability Policy.

h) In case any village is located within the mining leasehold which is not likely to be affected due to mining activities during the life of mine, the Expert Appraisal Committee (EAC) should consider the proposal of Environmental Clearance (EC) for reduced mining area. The Mining lease may be executed for the area for which EC is accorded. The mining plan may also be accordingly revised and required stipulations under the MMDR Act, 1957 and MCR, 1960 met.

i) Transportation of the minerals by road passing through the village shall not be allowed. A 'bypass' road should be constructed (say, leaving a gap of at least 200 meters) for the purpose of transportation of the minerals so that the impact of sound, dust and accidents could be mitigated. The PP shall bear the cost towards the widening and strengthening of existing public road network in case the same is proposed to be used for the Project. No road movement should be allowed on existing village road network without appropriately increasing the carrying capacity of such roads.

j) Likewise, alteration or re-routing of foot paths, pagdandies, cart roads, and village infrastructure/public utilities or roads (for purposes of land acquisition for mining) shall be avoided to the extent possible and in case such acquisition is inevitable, alternative arrangements shall be made first and then only the area acquired. In these types of cases, Inspection Reports by site visit by experts may be insisted upon which should be done through reputed Institutes.

k) As CSR activities by Companies including the Mining Establishments has become mandatory up to 2% of their financial turn-over, Socio Economic Development of the neighborhood Habitats could also be planned and executed by the PPs more systematically based on the 'Need

based door to door survey' by established Social Institutes/Workers on the lines as required under TOR. "R&R Plan/compensation details for the Project Affected People (PAP) should be furnished. While preparing the R&R Plan, the relevant State/National Rehabilitation & Resettlement Policy should be kept in view. In respect of SCs /STs and other weaker sections of the society in the study area, a need based sample survey, family-wise, should be undertaken to assess their requirements, and action programmes prepared and submitted accordingly, integrating the sectoral programmes of line departments of the State Government. It may be clearly brought out whether the village located in the mine lease area will be shifted or not. The issues relating to shifting of Village including their R&R and socio-economic aspects should be discussed in the EIA report."

3. The matter was examined in the Ministry and accordingly, it has been decided that the above mentioned conditions at para-2 (a-k) may be included as a condition of Environmental Clearance letter to mitigate the adverse impact of mining operations in the case of such habitations/villages.

4. This issues with the approval of Competent Authority.

(Dr. V.P. Upadhyay)
Director(s)
Tel: 24695304
Email- vp.upadhyay@nic.in

To:

1. All the Officers of IA Division/ROs of MoEF &CC
2. Chairpersons/Member Secretaries of all SEIAAs/SEACs.
3. Chairpersons/Member Secretaries of all SPCBs/UTPCCS

Copy to:-

1. PS to MEF.
2. PPS to Secretary (E&F).
3. PPS to AS (SS).
4. PS to JS (MKS).
5. PS to JS (MS).
6. PS to JS (BS).
7. Website, MoEF.
8. Guard File.

(Dr. V. P. Upadhyay)
Director(s)